Costs Incurred in Road Construction

(Co-efficient: Per square yard of carriageway)

Phases of Construction	Early Contracts (1959–61)				Middle Contracts (1961–63)				Latest Contracts (1963–65)			
	Labour	*Plant*	*Materials*	*Total*	*Labour*	*Plant*	*Materials*	*Total*	*Labour*	*Plant*	*Materials*	*Total*
	s. d.	*s. d.*	*s. d.*	*s. d.*	*s. d.*	*s. d.*	*s. d.*	*s. d.*	*s. d.*	*s. d.*	*s. d.*	*s. d.*
Preliminaries	11 2	4 9	—	15 11	17 11	13 8	—	31 7	28 3	13 1	—	41 4
Earthworks	9 11	23 9	4 10	38 6	14 9	29 6	6 0	50 3	14 2	39 0	6 6	59 8
Carriageway	16 7	16 1	30 11	63 7	8 2	9 1	42 9	60 0	8 6	8 0	44 4	60 10
Drainage	6 2	2 3	4 9	13 2	7 0	2 3	14 1	23 4	8 7	3 8	11 4	23 7
Structures	20 10	7 5	20 2	48 5	25 3	10 10	46 6	82 7	16 10	11 3	30 1	58 2
Fencing and Side Roads	7 8	3 2	8 7	19 5	4 0	1 9	10 0	15 9	4 8	2 9	9 7	17 0
TOTAL	72 4	57 5	69 3	199 0	77 1	67 1	119 4	263 6	81 0	77 9	101 10	260 7
Comparative Indices	100 —	100 —	100 —	100 —	107 100	117 100	172 100	132 100	112 105	135 116	147 85	131 99

Notes:

1 The costs shown in this table represent the historical costs for each group of contracts. The costs of each contract within each group have been adjusted by percentage additions to allow for increases in basic wage rates and plant and materials costs, *to the level of prices current at the middle point of the last contract in that group*. The middle point for each group is: early group – October 1961; middle group – October 1963; latest group – February 1965.

2 The co-efficient used to express comparative costs in this chart is one unit of the total area (in square yards) of new carriageway laid. This area includes carriageway, underbridges and slip roads, but does not include areas of new carriageway laid as diversions to existing roads.

3 The three groups of contracts are not uniform in their composition, so that, for example, the amount as well as the cost of structural work and earthworks per square yard of carriageway varies from group to group.

1 Introduction

Our approach to our task

1.1 We began with a broad survey of costs, prices and productivity in road construction. We found that a good deal of information was available on road construction prices. We learnt that prices, as shown in bills of quantities, had risen by about 30% in the years 1960 to 1962, and by a further 9% in 1962 to 1964. During the period, the increase in cost per mile was even greater, for the Specification was stiffened. We also found that there was little information about the cost structure of the industry, or about the trend of these costs in the period. Accordingly, we commissioned a firm of chartered quantity surveyors, Gardiner and Theobald, to carry out a study of road construction costs, and we give a preliminary discussion of the results in chapter 7. We also concluded that the definition of productivity was not straightforward, and the measurement of productivity could not be attempted without much detailed information about the resources employed in road construction and their costs. We decided therefore not to attempt to consider productivity in the abstract until we had the results of our costs study.

1.2 In fact, though, it is more urgent to improve productivity than to measure it. It is always important to achieve the best value for money. The steep rise in prices over the last few years, and the great expansion that is planned for the road programme over the next few, made it seem all the more urgent to look out for whatever possibilities there were for immediate action. We therefore aimed to formulate as quickly as possible recommendations for improvements that could be put in hand straightaway. We have given first priority to that. We decided, too, that we would make best progress if we pooled the experience that members of the working party already had. At this stage in our work, we have not consulted or sought evidence from outside individuals and bodies. We thought that the results of our costs study, when they were available, would shed more light on the conclusions we were reaching. We think it would be appropriate at the second stage of our work both to seek evidence and opinion more widely, and also to follow up any aspects of the problem that we have not discussed, but which are pointed out by the costs study.

1.3 We soon appreciated that we could cover the major part of the road programme by focusing our attention on motorway schemes and the largest trunk road schemes in England, which are the responsibility of the Ministry of Transport. We have done so: we have not paid special attention to Scotland or Wales; we have not considered the smaller schemes, nor have we studied local highway authorities' schemes in the classified road programme. The parts of the programme we have considered have much in common with the parts we have not, but there are also general differences: notably that the Ministry is responsible for a vastly larger programme than any other single highway authority, and that most of the major classified road schemes are likely to be in urban areas. Our views, then, are based on consideration of only the major element in the whole

road programme. What we say may he more or less applicable to other road construction works, and many of the recommendations we address to the Ministry of Transport are applicahle in greater or lesser degree to other highway authorities. Nevertheless we would make clear that this first report deals with the construction of motorways and major trunk roads.

1.4 We considered that we were not fitted to make any detailed analysis of such technical matters as the Specification, or standardisation, which are, in any case, the concern of other hodies and institutions. On such matters, we could only familiarise ourselves with what was heing done, and judge whether sufficient attention was paid to them, and whether that attention was directed to the most important aspects.

1.5 Our conclusions and recommendations represent a concensus of opinion within the working party. We started from diverse points of view. Nevertheless, we have generally reached unexpectedly close agreement on the subjects we discuss in this report. We think it is possible to give in it a clear and unambiguous statement of the main lines of our collective thinking, and see no need to spell out differences of opinion that still remain among us on a few points. We must emphasise that we were appointed to this task as individuals. Accordingly, it is as individuals that we put our names to this report, for none of us is in a position to commit anyone hut himself.

The implications of our work

1.6 Our salient impression is that since the road programme began its rapid expansion eight or ten years ago, contractors, designers and the Ministry itself have learnt some hard lessons. Since then, working methods, procedures and attitudes have developed, so that they are now more appropriate than they were to a large programme of major road construction works. As will emerge, however, we think there is scope for further progress, which could promote greater efficiency and lower prices in the long run. These are the main aims which we think should underly future developments:

(a) **more continuity of work,** for plant, for contractors' teams, and for design teams;

(b) partly as a consequence of greater operational continuity, more **specialisation in major highway works**; this too applies to plant, contractors' management teams, and design teams equally;

(c) as a means to continuity and specialisation, **a more rational distribution of work** to a smaller number of contractors' teams and design teams;

(d) **better communications**; more feedhack from contractors to designers on the practical cost implications of design; clearer statements by the Ministry of the contents of its forward programme, and of the prospects for contractors and suppliers of materials;

(e) **more collaborative working** between contractors and engineers, hetween engineers, contractors and statutory undertakers, between contractors and the Ministry: this might include earlier participation by the contractor in the preparation of some projects;

(f) **a closer analysis of costs and benefits**: in the Specification, and in the choice hetween alternative methods of construction (black top or concrete paving; precast or *in-situ* bridge construction; shorter or longer contract duration);

(g) a clearer appreciation of **the price of public accountability**: in the time and effort devoted to consultations and negotiations hefore the line of a new road

and the right of entry to land are statutorily established; in the Ministry's attitude to the risk of poor performance in the finished road; in its willingness to try out innovations in contract procedure.

In general, under present procedures, competition tends to squeeze prices in the short run. Profits are squeezed, and so is expenditure that contractors might incur in order to bring about long-term cost savings. The long-term advantage lies however in achieving these cost savings, and that is the object of our recommendations.

1.7 We have two more points to make by way of introduction. First, road construction is peculiarly open to any influence that the Government decides to exert, because the Ministry of Transport itself is the client for most of the work, and pays grants to local authorities who are the clients for the rest. We are convinced that in pursuit of the best value for money in road construction, all concerned in the industry must accept changes; changes in the Ministry of Transport's own practices and the procedures and framework within which it operates; changes too in the disposition of contractors, and in the ways of engineers. Even where change is required in the practice of contractors or engineers, it will often be for the Ministry of Transport to take the initiative in stimulating the change. It is for this reason that we have addressed a substantial number of our recommendations to the Ministry. We hope however that the number of recommendations so addressed will not be misrepresented as implying that all the industries' present shortcomings are the fault of the Ministry. Such a misinterpretation would not only be unfair; but it could also set back the close collaborative working between all sides of the industry which has led to the production of this report. The initiative of the Ministry in making changes can only be successful if contractors and engineers co-operate fully to bring them into effect.

1.8 Second, road construction is the largest single sector of the civil engineering industry, and may be said to be representative of the whole. If practices in road construction can be improved, desirable changes in other sectors may follow of themselves, and should certainly be achieved more easily. The Ministry is in a powerful position to bring about greater efficiency, not only in the road construction programme itself – important as that is – but throughout the civil engineering industry. The opportunities should not be neglected.

2 The Structure of the Industry

The road conatruction induatry today

2.1 Road construction in Great Britain now accounts for an expenditure of about £160 million in a single year. In real terms, it is substantially bigger than it has ever been before. Ten years ago its total value was about £10 million. By 1970 it will be worth about £300 million. Even so, it is small by comparison with the road programme in the United States, or in the developed countries of Western Europe, and all the indications are that it ought to continue to expand rapidly in this country in the 1970s. There can be few industries of any significance which have expanded anything like as fast, or which have better or more assured prospects of expansion in the future. In this situation it may seem surprising that contractors, almost with one voice, regard the lack of an assured market for their services as the biggest obstacle to efficiency.

2.2 In civil engineering, as distinct from building, road construction is now the largest activity, accounting for about a quarter of the whole. However, it has hardly developed yet as a distinct sector within the civil engineering industry. Most road construction contractors undertake work of other kinds: indeed, house building, office building or other types of constructional work are more important even to many of the firms with the largest road-building turnover.

The importance of continuity

2.3 Major contracts for roadworks normally extend over two years. A scheme of £4 million might typically involve the procurement of materials from 30 suppliers, the organisation of up to 200 operatives and 40 other staff, the handling of 130 items of plant, relations with 15 sub-contractors, and up to 2,500 interrelated activities on a critical path schedule. The problems of management in road construction are complex. Equally the technical problems, if not unique, have more of a family resemblance between one road job and the next than between roadworks and other kinds of civil engineering work. In each contract therefore the quality of the contractor's management team is of critical importance if the job is to be profitable to the contractor, if resources are to be used efficiently and if the community is to have the benefits of prompt and proper completion. Road construction is no work for novices, as is shown by the extent to which well-established contractors, having no recent experience of large scale road-works, underestimated the difficulties of carrying out the early motorway contracts. If management teams have to be formed *ad hoc* for a road contract, and are dispersed again to other types of construction work when it is done, the quality of management is bound to suffer; in each contract irrecoverable errors of judgement will be made and the losses to the contractor and to the community will be substantial. On the other hand, there are appreciable gains on the rare occasions when a management team can move intact from one road job to the next.

2.4 Some special road construction plant is used as little as 25 per cent of the

working hours in its life. Thisis a low average for the utilisation of expensive equipment. It is only partly due to the fact that little work can be carried out in the winter. For it is also the case that when a piece of plant has completed its phase in a contract, it may stand idle for months even in the construction season. Specialist paving equipment can be used on three separate major contracts in one season, but it is exceptional for a contractor to be able to use much of it more than once. In consequence, there is a needlessly heavy burden of overheads on top of the cost of operating the plant. This has a direct effect on prices.

2.5 It also has an indirect effect, for contractors and specialist subcontractors are deterred from investing in the most expensive or specialised plant by the unlikelihood of making over a period of years an adequate return on their investment. They feel bound to insist on an assured and quick return and so prefer to buy plant that is cheaper, and which they expect to be able to use more regularly – 12 foot pavers rather than 24 foot pavers, for example. Or, just to keep expensive concrete-paving plant employed, they have to try using it for laying sub-bases, which could be done by less elaborate machinery of a much smaller capital cost.

2.6 For the same reasons, contractors are unwilling to invest in experimental plant, although the development of better types of plant is one of the essential conditions for greater efficiency. Operations which have a relatively important place in American road construction – notably excavation and paving – are highly mechanised, and the British contractor can procure economical and efficient plant for these phases of the contract. There have been useful advances in tbis country in plant of some types – for example in asphalt pavers and concrete-batching plant. On the other hand, development has been slower for operations that constitute a larger proportion of roadworks on this side of the Atlantic, notably the provision of drainage and the building of structures. We think that the small size of the British market deters plant manufacturers from developing new types of plant for these purposes, and that the British contractor's uncertainty about his own future deters him too from promoting plant development here. This illustrates how the pressure that wide competition exerts on profit margins tends to work against long-term economies.

2.7 Thus there are good grounds for the common observation that a major obstacle to greater efficiency and productivity is the absence of any assurance, in each contractor's organisation, of a steady and sustained demand for his services in road construction. There is a real need for greater continuity of work, if we are to keep employed, and to promote, the development of specialised management teams, and specialised road-building equipment. *We conclude that the disposition of work should be such as to provide greater continuity of work for individual firms engaged in road construction.*

The distribution of work

2.8 The number of major contracts on offer is small, and it can provide a continuous programme of work for only a limited number of management teams specialising (as they should) in road construction. Management teams are hardly likely to be transferred *en bloc* from contractor to contractor, and so *we consider that not many firms can play an important role in the execution of major contracts in the programme.*

2.9 Within a region, the incidence of the largest road contracts fluctuates, though there is a steadier flow of smaller-scale work. A firm that confines its activities to

a limited area may be able, on occasion, to mobilise the necessary resources to undertake a major contract at a competitive price, but it is unlikely to find there a steady demand for large-scale work, and so it is unlikely to reap the advantages of continuity. The small firms may be well able to tackle the larger jobs as members of consortia. The long-term advantages of size accrue, however, only if these consortia last, and the necessary quality of management will be available only if at least one member is large enough to have had experience of major road contracts. Under these conditions, the consorting firms are operating in effect, if not in form, as a single larger entity with a definite management capability. *We conclude that in general there is little room for the small firms as main contractors on large road construction contracts.*

2.10 With these considerations in mind, we have reviewed the incidence of road construction work over the industry during the last few years. The general picture is this. The number of contractors accepted by the Ministry as qualified to undertake contracts of over £250,000 is about ninety. (They are classified according to the size, nature and location of projects, and about fifteen are eligible to tender for a major motorway contract.) During the three years from 1962 to 1964, the number of contracts of over £250,000 in value placed by the Ministry for motorway and trunk road works was also just over ninety.

2.11 As it turned out, these contracts were placed with about fifty different firms, and so, in the three years, some forty firms judged capable of executing a contract in this price range did not in fact win one. During the two years up to 1st March 1966, about seventy contracts in this category were awarded to about forty firms, and so about fifty qualified firms did not win one. Further analysis showed that during the three years 1962 to 1964, over 50 per cent by value of the contracts were won by ten firms, out of the fifty odd who shared the ninety or so contracts; during the two years up to 1st March 1966, 50 per cent by value of the contracts went to seven firms out of the forty. On the other hand, in the first period 27 firms won only one contract each, and in the second 24 firms. It is evident that as long as so many firms of contractors are in the field the number of contracts available will not afford the continuous operation in this sort of work which we and the industry consider so desirable.

2.12 If a firm carries out only the occasional major road contract it is liable to make mistakes as it gains experience, without going on to benefit from this experience to the ultimate advantage of the client. Equally, if so many contracts are awarded to firms who win only the occasional one, no firm, however efficient, can count on continuous operation with a sufficient degree of assurance to plan and invest for the maximum long-term cost reduction. Our review did not include classified road schemes, some of which are substantial, and the figures show that in the last two years there has been a gradually increasing degree of concentration compared with the previous three. We are sure, however, that this process has not yet gone far enough, *and we consider that both the Ministry and the contractors themselves should aim to concentrate the execution of major road construction contracts in the hands of fewer teams.*

The way to concentration

2.13 We appreciate the argument that if firms of large road construction contractors were reduced to a very small number, there would be a danger of price-collusion. We do not contemplate however the elimination of effective competition, and in fact there are real safeguards. The demand for road construction is

concentrated in powerful hands, and the clients are well able to cultivate new suppliers. The very large field of small and medium-sized contracts will always provide scope for smaller firms, and opportunities for them to graduate progressively to the largest scale of operation. If at any time there appeared to be a risk of price-collusion over the largest contracts, the Ministry could readily take steps to prevent it.

2.14 The selective tendering procedure operated by the Ministry provides for the standing of qualified firms to be reviewed in the light of their performance; and, when it selects firms to tender for particular contracts, it attempts to give contractors opportunities for continuity of working. The selective tendering procedure has been operated by the Ministry for only three years for the largest contracts – and, for contracts of less than £1 million for an even shorter time – but now the system has been established it should be used, with purpose, to eliminate the dead wood from the lists of qualified firms, and to promote a higher degree of continuity of working for those firms – of whatever size – who have shown themselves able to play an effective part in executing the road programme.

2.15 We think the Ministry should, in the first place, review its list of qualified firms for major contracts and remove those which, in the light of their record in recent years, cannot claim to have a serious interest in road construction. In selecting firms to tender for contracts, the Ministry should make a point of sending invitations to tender to firms who have undertaken a large volume of work recently, rather than attempting to provide repeated opportunities for those who have not. We understand that the Ministry is considering sending invitations to tender earlier, and this would give contractors who wish to tender more opportunity to ensure that the necessary resources are standing by: they should not have to decline invitations to tender. It is also considering the possibility of serial contracting, and serial contracting could lead to a greater concentration of work in the hands of a smaller number of firms. Perhaps, too, the Ministry could be more ruthless in penalising contractors for unsatisfactory performance, by reducing their standing in the list. It is the Ministry's intention that firms should be able to rise in the list, that the smaller firms should be able to graduate eventually to its higher reaches and that unsatisfactory firms should be disqualified or relegated. To be effective however this process must be seen to be operated in a vigorous and purposeful way. *We recommend the Ministry to ensure that the working of its selective tendering procedure enables all firms, including the largest, to have every opportunity to develop in standing and calibre, and in their capacity to take on more contracts at a time; we also recommend them to ensure that unsatisfactory firms are relegated or discarded.*

2.16 The mutual benefits of concentration and continuity cannot be achieved by the Ministry alone however. Contractors have their part to play. There have been indications that even some of the largest firms are reluctant to assume commitments for road construction on the scale we envisage. The system has provided too little assurance of continuing employment to justify the requisite investment. It may well be that few firms of civil engineering contractors will ever wish to base their business exclusively on road works. On the other hand, any firm that succeeds in securing a substantial and uninterrupted flow of road-construction work can achieve the advantages both of specialised management and of fuller utilisation of plant. Such a firm should be able to operate on each job with a lower margin for overheads, its competitive position should be

stronger, and its future should be more assured. *Firms that do engage in road work would, we conclude, do well to make a substantial commitment to this activity, whatever else they may do as well.* As things are, we doubt if there are more than one or two firms who would be willing – even if they were able – to maintain a continuous stream of, say, half a dozen contracts at any time. Certainly, it would be risky for a firm first to decide to double its commitment to road works, and then to try to invest and price its way into achieving this objective. There are other ways however in which firms can expand their activities, *and we recommend firms of all sizes in the industry to consider the advantages of amalgamation, or of permanently combining their road-construction interests in jointly-owned subsidiaries.* Some degree of concentration is likely to come through natural evolution, but we would expect natural evolution to be a more painful process for the firms themselves.

Sub-contracting

2.17 Sub-contracting has already come to play an important part in road construction. The specialist firm, having the advantages of specialist plant, and a more continuous flow of work, can often quote to a main contractor a price that he himself cannot match. For the future, the advantages of more specialised and more expensive plant will become more pronounced, provided that it can be kept continuously employed. This may foster an increase in the extent of sub-contracting. If the number of main contractors is reduced, some firms, who now operate as main contractors, may find a more assured future as specialist sub-contractors.

2.18 The employment of sub-contractors has its disadvantages, however. The main contractor is in a position to drive a hard bargain with sub-contractors, and some contractors make a practice of exploiting this. The sub-contractor for his part is naturally concerned first and foremost with his own interest, rather than with promoting the best progress of the operation as a whole. If, as a result, work is held up by sub-contractors, or where there are disputes between main contractor and sub-contractor, the client and the engineer cannot take effective action so far as that job is concerned. Thus there are misgivings about contractors who sub-contract a large proportion of a job, and it is sometimes suggested that clients should impose an arbitrary general limit on the extent of sub-contracting.

2.19 However, sub-contractors have carried out half or even more of some projects with satisfactory results, and so we do not see how a sensible general limit can be laid down. The main contractor is fully responsible for the performance of his sub-contractors and for dealing fairly with them, and in practice, the only effective sanction is to enforce this responsibility. In our view, the main contractor's overriding and primary function is one of good management. He carries the responsibility for the proper execution of every phase of the contract, and the proper execution of each phase (whether sub-contracted or carried out by the main contractor on his own account) depends on the quality of his management, as does the proper co-ordination and control of the contract as a whole. If a client is dissatisfied, he need not employ the contractor again, or can employ him only on schemes where the co-ordination of sub-contractors is less likely to give rise to difficulties.

The development of plant

2.20 We have already observed that the structure of the industry is not par-

ticularly favourable to the development of new or better types of plant. We have drawn attention to some phases of road construction for which more productive and more specialised equipment is clearly needed. At our invitation, therefore, the National Economic Development Office is suggesting to representatives of plant manufacturers and road construction contractors that they consider together what gaps or shortcomings there are in the equipment now available, and how far they can be remedied. Until now, because individual contractors have not had great confidence in their own future in road construction, and because there has been no focus of demand for better equipment, plant manufacturers may have been misled into underestimating or discounting the likely demand for their products. *We recommend both contractors and plant manufacturers, in considering investment in innovation to take an optimistic view of the likely growth of demand for roads and for better road construction plant in this country and abroad.*

2.21 The Ministry of Transport can help here too. It has already sponsored an investigation in the United States of developments in road construction plant there (reference 1). It has encouraged the introduction of four types of plant as a result, and has arranged trials for one of them. Where, as in the last case, innovations in plant design require amendments or additions to the Ministry's specification, it is appropriate for them to bear the cost of trials. For innovations in the design of plant go hand in hand with changes in the specification of the finished product, which is the Ministry's responsibility. The contractors who carry out such trials stand to gain too, of course, but in the long-term this is very much in the interests of the Ministry and of the nation. *We recommend the Ministry to go on looking out for innovations in plant design abroad, and to promote trials of such plant in appropriate cases.*

Shift-working

2.22 Shift-working is not common in road construction, though it is used tactically to eliminate a local bottleneck in the contractor's work programme, or to catch up when the work falls behind. To the contractor, the advantages of lower plant-ownership costs are offset by extra labour costs (for maintenance at weekends, and for premium payments for shorter shifts) and also by the difficulty of ensuring a satisfactory standard of plant maintenance and a satisfactory quality of output. On the other hand, as plant develops and becomes more expensive, its fuller utilisation through shift-working becomes increasingly economic to the contractor, provided that there is a steady flow of work from contract to contract.

2.23 The community stands to gain from the earlier completion of a contract as a result of shift-working. It may be that the most economic contract duration from the community's point of view is shorter than the contract period which, without special incentives, is most profitable to the contractor. Under present arrangements for government financing, the roads budget is limited, and incentive payments for earlier completion on one scheme would mean less money for others. The Government does not recognise the advantages of reducing the time during which capital stands idle. It may be too that some contractors' accounting procedures do not help them to evaluate its profitability correctly even under present contractual arrangements. We have already prompted the Ministry of Transport to commission a study on operational research lines of the economics of shift-working. *We recommend them also to consider the possibility of contrac-*

tual arrangements that would give incentives for early completion as well as a liability to damages for late completion.

Summing-up

2.24 We have found that the structure of the industry is not geared to the greatest possible improvement in efficiency. There are too many firms in the field for the number of contracts on offer. As a result, firms have too little confidence in a continuing demand for their services, their plant and management teams are not employed continuously, and they are discouraged from building up an organisation that would achieve the greatest possible cost savings in the long term. Natural evolution is unlikely to provide the right framework; in any case it will not work quickly enough. We have recommended purposeful policies of greater concentration of work and greater specialisation in road construction, in order that the structure of the industry can be improved, and the country can realise more fully the long-term cost savings that are technically possible.

3 Technical Policy

Introduction

3.1 In this chapter, we discuss the Ministry's general standards and principles for the design of road and bridge works. These general standards are set out in three Ministry publications: *The Specification for Road and Bridge Works, Notes on the Ministry's Specification, and on the Preparation of Bills of Quantities*, and *Guide to the Structural Design of Flexible and Rigid Pavements* (references 2, 3 and 4). These memoranda prescribe the standards that must be achieved in construction in different materials and in different circumstances. In designing a particular project, the designer draws from these general memoranda the particular specification that he considers appropriate for the prevailing circumstances and the form of construction he has selected.

The specification and construction costs

3.2 At present, for the second time since 1958, the Ministry is revising its general specification, with the usual consultations with all sides of the industry. The specification used in the first motorway contracts proved to be unsatisfactory in some respects for service in the traffic conditions that had developed since before the war. About the turn of this decade, many modifications were worked out, and had to be introduced immediately, before they could be issued in a revised edition of the Ministry's general specification. Latterly, new developments and increasing experience have given rise to further changes, though these have been fewer and less far reaching.

3.3 Changes in the specification have had a substantial impact on the cost of road construction. The Ministry estimated in 1962 that, on average, the effect of changes made over the previous two years was an increase in the cost per miles of dual-three lane motorway of £70,000 per mile. In the light of further evidence we received, we asked the Ministry to reappraise its estimate, and they now conclude that if two subsequent changes are taken into account, and if the estimate is updated to 1964 prices, the current estimate of the increase is between £100,000 and £110,000 per mile. The evidence is extremely difficult to analyse, and indeed, the techniques of analysis are so approximate that any two people, after close study, are unlikely to come to close agreement in evaluating the matter. *Still, we have concluded that the effect on costs of changes made in the specification in* 1960–1964 *is* (*at* 1964 *prices*) *at least* £110,000 *per mile for dual-three lane motorways.*

3.4 There are great difficulties in the accurate analysis of the cost effects of changes in the general specification. The only evidence at present available to the Ministry about the costs of road-building operations is contained in priced bills of quantities, and these are a poor guide to the true cost of the underlying operations, as is shown by the wide variation between one tender and another in the price for a single item in the same contract. The contractor does not necessarily intend the unit price in a tender to reflect the underlying cost of the

operation; in any case his estimate of the underlying cost may prove to be wide of the mark, particularly if the estimated quantity differs appreciably from the quantity of work that the item turns out to require. There are two further difficulties. In evaluating the general effect of changes in the specification, it is wrong to assume straightforward conditions, since in practice the effect may differ substantially in difficult conditions. The factors that make conditions of construction difficult are various, and may not necessarily be predictable, yet the analysis implies taking a view of the ease or difficulty of constructing to different specifications over the generality of contracts. Again, if the effect of changes is to make an appreciable difference to the time required for particular phases of the contract (and this will depend in part on the time of year at which contracts are let), then these changes may make a material difference to the contractor's cash-flow and to the pattern of utilisation and lock-up of his capital equipment. This has so far defied precise analysis.

3.5 We have no hesitation in saying that in considering proposals for changes in the specification, the Ministry have always devoted considerable effort to evaluating the cost effects. As we have said, however, the information they have is not good enough for a close evaluation of these effects. Nevertheless, decisions of technical policy can have substantial (and unsuspected) effects on construction costs, and we think it is important that those responsible for framing design requirements should understand as well as possible what these effects are. The Ministry could get better information only if contractors were prepared to make it available. *We therefore recommend the Ministry of Transport to build up a more exact model of the capital-cost implications of design requirements.* This can only be done if contractors can make relevant data available in a suitable form, *and we recommend contractors to assist the Ministry as far as they can in this.*

The specification and value for money

3.6 We are not in a position to report in detail on the advisability of the particular changes that have been made to the specification. Indeed, we are not qualified to do so. We have some general observations to make however. Devising a specification is a highly technical matter, and, in all fields, those responsible for a specification tend to aim first and foremost at a high technical performance. However, technical perfection is worth pursuing only up to a point. It is erroneous to assume that features that are undoubtedly technically excellent will necessarily be worth the money, somehow or other, in the long run. The more difficult it is to evaluate costs and effectiveness, the more likely it is that the finished product will be overspecified. We cannot point to any of the Ministry's requirements and show that they are overspecified, but because these requirements are technically complex, and because it is difficult to appraise their costs and their effects, they may well include some examples of over-specification.

3.7 We do not underestimate the difficulties of evaluating the cost-effectiveness of features in a specification for road and bridge works. Evaluations of this kind require a clear view on the general question, how well one should aim to provide for the future. It is necessary to take account both of initial capital costs, and of subsequent maintenance costs – and the economical choice may be the alternative with the higher capital cost and lower maintenance costs. It is also necessary to assess the risk of failure, the cost consequences of failure

and the cost of reducing the risk of failure. This presents particular difficulties to a government department such as the Ministry of Transport, because, however carefully and correctly the Ministry have assessed the risk of poor performance, they can expect to face a public outcry if ever a road does not perform satisfactorily. Nevertheless, if the public insists on perfect performance in every piece of construction, it will have to pay a high price.

3.8 In recent years, much experience has been gained of the performance of different materials both in service and under research conditions. It is now increasingly possible to make closer estimates of performance. Indeed, the Ministry has been able to reduce its requirements for some features of the specification, in the confidence that this will not lead to an excessive risk of failure. There is, too, a growing body of knowledge of the cost of maintaining roads constructed to different modern specifications, and as time goes on, it is more and more possible to compare these, as between different methods of construction or in different conditions of service. Techniques of investment appraisal have also developed a long way in the last few years. It is more and more possible for the Ministry and others to pull together these various strands of knowledge and expertise, to quantify the relevant costs and estimate the risks, and so to appraise their requirements. We are confident that the more progress they can make with this, the more ways they will be able to find of making savings without taking imprudent risks.

3.9 The specification alone presents a very large field for investigation: it may include traditional features which, as time goes on, become disproportionately costly. Much information is available on the specifications adopted in foreign countries. In chapter 7 we refer to the evidence we have received from the Gardiner and Theobald study on the effect on costs of changes in the Ministry's requirements, and with this particularly in mind, we think special studies should be undertaken of the available data on the cost and performance of specifications and standards other than those at present in force in this country. It has always been the Ministry's practice to apply its informed judgment to these, in considering whether they should be adopted here. This informed judgment is essential if good decisions of technical policy are to be made. We are sure, however, that recent developments of theory can illuminate this field, and make informed judgment easier and surer. *Accordingly, we recommend the Ministry to develop its techniques of appraising cost-effectiveness as a guide to decisions of technical policy, and we recommend them to make extensive studies of the costs and performance of alternative specifications, particularly those actually used abroad.*

Standardisation

3.10 The Economic Development Committee particularly invited us to consider standardisation and variety reduction in road and bridge works. We are in no position to make a detailed examination of the standards that have been prepared or are in preparation, or to study and judge what particular opportunities there are for further progress. We have learnt from the Ministry what has been done to promote standardisation, and what is being done now, and we have been able to take a general view of the importance of this work, and the adequacy and correct orientation of the efforts that are now being made.

3.11 Most people involved in road construction can think of features which they think ought to be standardised. In many cases, there are good reasons why they have not been. It is imprudent to standardise before the best treatment,

or desirable standard of performance has been established. Expansion and contraction joints in concrete paving are a case in point. We think though that too long is being spent in some cases in research, experiment and evaluation, or too high a degree of technical perfection is being aimed at for the standard. In other cases, there is no standard because the treatment of a particular feature has seemed too trivial a matter to deserve attention: some of us speak highly of the American practice of issuing standard specifications that go into great detail, and standard drawings so detailed that they can serve as working drawings. Taken as far as this, standardisation simplifies the task of the designer as well as that of the contractor and might permit shorter and simpler bills of quantities. In general, the Ministry of Transport has not standardised in this detail, though its memoranda on design have been kept up to date so as to incorporate technical advances without permitting much indefensible variety.

3.12 For bridge design, there are general standards of performance and more detailed standards embodied in codes of practice. New codes of practice are being devised. The Ministry has also co-operated in the development of precast-concrete bridge beams and expects to make similar progress in composite steel-and-concrete construction. This should react favourably on prices of concrete beams, and so there should be general cost savings for bridges. So far both in this country and in the United States bridges constructed *in situ* have generally been cheaper than bridges constructed from precast components. However, prefabrication makes for quicker and easier construction, and so may reduce the cost of works on the road in the vicinity. Again, the cost of precast members might be reduced by bulk ordering. *We recommend the Ministry of Transport to keep the overall economics of prefabricated bridges under review.*

3.13 All in all, *we conclude that the Ministry has made useful progress with the promotion of standardisation.* This has not yet had time to make its full impact on costs, but past and present efforts should have a favourable influence in future. We have no general observations to make on the priorities the Ministry have set themselves within the resources available. We are glad they recognise that there is further progress to be made in this field, and *we recommend that their resources be strengthened to enable them to make it.*

The use of materials

3.14 The Ministry of Transport's specification permits the use of both concrete and bituminous materials (in various combinations) in the construction of carriageways. Black-top materials predominate. This is the result of general experience over a long period of the relative costs of construction and maintenance in the two materials. Concrete construction is unsatisfactory in some areas where there is mining subsidence, but elsewhere, many contracts are drawn up on alternative specifications so that the two materials are in direct competition, and some contractors, at least, think it worth their trouble to price in both materials before submitting a tender.

3.15 The Ministry have aimed to keep open the alternative of bituminous and concrete pavement construction, in order that producers of each material will be spurred by competition to improve their productivity and keep construction costs down. The policy has been conspicuously successful at times. For example, between 1960 and 1962, prices of asphalt paving increased by only 2 per cent, although workers engaged in the production of asphalt had substantial wage increases. On the other hand this policy discourages materials suppliers from

planning their production. Cement was scarce in 1964 because the cement industry had not been able to plan and invest for sufficient output.

3.16 It would certainly help suppliers of materials if they had forecasts of the likely requirement for their products. It is appropriate for road construction to take the lead in this for two reasons: in the first place there already exist, though not necessarily in published form, more definite forecasts of the demand for work on the road programme than for any other sector of the construction industries. In the second place, major road schemes use very large quantities of materials – one estimate is 100,000 tons of material for a mile of three-lane motorway – and depend very much on local sources of supply. The volume of road works in any locality varies much more than the volume of other types of constructional work, and so a road scheme can create an enormous peak of local demand. This applies even to those materials like cement of which, nationwide, only a small proportion is required for roads. Suppliers of materials would therefore benefit particularly from forecasts of requirements for road schemes, all the more if they are presented on a detailed geographical basis, and distinguishing types and tonnages of materials in a way they can readily assimilate. *We recommend the Ministry of Transport to publish from time to time forecasts of the likely demand for materials for road works, in a form that will help the suppliers of materials to plan and invest for a sufficient output.*

3.17 The Ministry may need to revise its present conceptions about the balance between concrete and bituminous paving. Recent innovations in the technology of concrete paving have resulted, for example, in a machine with sufficient output to produce in a year up to 35 miles of new dual carriageways, if material can be supplied at a sufficient rate. This is about a quarter of the mileage of motorways and trunk-roads built in a year, and more than the total annual mileage paved in concrete. Although the plant is expensive, and although there is room for only one or two machines of this type in the country at a time, such high output could bring about a substantial reduction in prices of concrete paving. This in turn should apply the spur of competition to those with interests in bituminous paving, and as bituminous materials are a by-product, the effect on bitumen prices could be significant. These benefits will not be achieved however if the proportion of concrete paving remains as small as it has been in recent years. If decisions are taken piecemeal, the Ministry may not get the cheapest price for all schemes taken together. Accordingly, *we recommend the Ministry to keep up to date its studies of the most economic balance between concrete and bituminous paving.*

Summing-up

3.18 We have found that more and more knowledge is becoming available of the implications of using alternative specifications, materials and methods of construction. We think that the analysis of this information should be taken further, with cost considerations in mind at every stage. Decisions taken in the design of individual projects are naturally based on historical costs and assume no great change in the framework of costs; but technical innovations and opportunities can change the framework of costs, and the cumulative effect on costs of many piecemeal decisions can easily be left out of the analysis. We should like to see a more broadly-based cost-consciousness in decisions of technical policy.

4 Design and Supervision

4.1 Having considered in chapter 3 the specification and standards in general, we now turn to the problems that arise in preparing the design and specification for individual projects, and in supervising the execution of particular contracts. We accept that engineers have shewn real cost-consciousness in the choice between alternative designs and in supervising the works, but there is always room for improvement, and it is our task to point the way to improvement. In doing so we do not intend to detract from the real achievements that engineers have to their credit.

The distribution of design work

4.2 To design and supervise major road schemes, the Ministry of Transport employs about 50 local authorities (mostly county councils) as its agents; it also employs some 30 firms of consultant engineers on major projects which, for one reason or another, it considers inappropriate to local authority design staffs. At the end of March 1965, these design teams had been invited to prepare between them about 150 motorway and trunk road projects of over £250,000, and they were also preparing about 75 programmed classified-road schemes in county areas. On average, each was preparing only about three major schemes at a time; some had a dozen or more, others one or none. In chapter 2, we concluded that the number of major road contracts on offer in the road programme was too small to afford a continuous flow of work to more than a few firms specialising in highway work, and that there were great advantages to be derived from more specialisation and greater continuity. It appears that there is even greater fragmentation of work among designers.

4.3 Highway design is a team operation, just as much as highway construction. A team cannot be fully effective from the moment of its formation, and will only be fully effective so long as it is continuously employed in the field where its expertise lies. If a design team finds that the flow of major highway work is interrupted, one of two things will follow. Either the team will stay together where there is no design work that is appropriate for it, and this wastes a scarce and valuable professional skill; the team's acquired expertise rusts, and its members lose touch with the development of ideas and practice in highway design. Alternatively, the members of the team leave, and go where the work is; the team itself is dispersed and an effective unit is destroyed. Either consequence is wasteful.

4.4 The large number of design organisations has the consequence that generally each one is small compared with one in, say, a typical American State Highway Department. The more design teams there are, and the smaller they are, the more likely it is that some will not be up to date with the best practice, or be capable of economically finding the best solution to the more intricate sort of problem. Equally, the more difficult it is for the Ministry to ensure that the right principles and ideas are incorporated into all design work. Contractors

find that fewer problems arise if the design-and-supervision team concerned with a project has already had experience with similar projects. Similar considerations apply in the supervision phase of the engineer's task; and we shall discuss the problems in this phase in the second half of this chapter. In practice, the quality of design teams is uneven, and whereas contractors who are not of the highest standard are likely to fare badly in competition with others, the less capable design teams do not pay so direct a penalty. *We conclude therefore that there are too many design-and-supervision organisations engaged on major highway work, and we recommend the Ministry of Transport to consider further measures to rationalise and concentrate design work to the best economic advantage.* Some neighbouring county councils have already made arrangements for collaboration in the design of individual projects, and this is clearly a step in the right direction. We realise too that county councils must maintain a design-and-supervision team for their own classified roads.

The need for feedback from construction to design

4.5 Our members from the contracting side of the industry have all said that designs for road works are seldom as cheap to carry out as they could be; that is, the contractor thinks (rightly or wrongly) that he can see opportunities for making savings on the original design. To some extent, this is because a designer cannot know in advance what treatment of a given feature will be the simplest for the particular contractor who is ultimately appointed. That apart, there are still deficiencies. Bridges are still designed, sometimes, so as to require too much temporary work. There is overelaboration. Some simple finishes and treatments are as pleasing to the eye as more expensive finishes and treatments. All in all, too little information on the practical aspects of design of road and bridge works is fed back from those engaged in construction to designers. Design engineers acknowledge their responsibilities here, and try to carry them out conscientiously, but they are hampered by the inadequacy of communication between contractor and designer. They need guidance on pitfalls to avoid, as much as they do on innovations to adopt. *We conclude that some additional means must be devised to bring to bear on designers' thinking the practical experience of contractors of the cost of alternative design treatments.*

4.6 Within the framework of the present contract procedures, some steps could be taken to this end. *First of all, we recommend that at the tender stage contractors should not be discouraged from submitting alternative tenders* (with prices based both on the original tender documents and on the alternative, as we recommend in paragraph 5.14).

4.7 When the client has adjudged the tenders, and decided which contractor to appoint, the chosen contractor may still be able to formulate and propose to the Engineer ideas for carrying out the work more economically than is allowed for in the design on which the tender has been accepted. This is no reflection on the designer, for he cannot know in advance exactly what design details or technique of construction will be most straightforward to the contractor who is ultimately appointed. The contractor should therefore be encouraged to put his ideas forward, and the designer should be encouraged to give them sympathetic consideration. In this context, encouragement means money. It will be necessary to devise arrangements whereby the contractor's profit is enhanced rather than reduced, and which are satisfactory to client and engineer too. The process may delay the contractor's starting work on the site, but a short delay will seldom

have any real importance at this stage. *We recommend the Ministry to encourage engineers to discuss his suggestions with a contractor who believes he can offer a significant saving, and, subject to suitable safeguards, to adopt them.*

4.8 As the contract proceeds, the contractor may discover features which, if treated in another way, could have heen constructed at lower cost, or he may devise working methods that are novel and economical. The engineer responsihle for the particular contract can take advantage of such lessons and incorporate them in future designs. However, they may deserve wider dissemination. We have therefore suggested to the Ministry of Transport that it might institute routine meetings hetween the Ministry, the designer and the contractor, to distil from each contract ideas for possihle future cost-savings. We are glad to say that the Ministry has decided to do this. It will he necessary for contractors to co-operate wholeheartedly in bringing forward their technical experience at these feedhack meetings, and *we recommend the Ministry to ensure that the important findings are disseminated clearly, quickly and universally among highway-design teams, so that they can be put into practice in future designs.*

4.9 In Chapter 5, we make proposals for innovations in contract procedures, including experiments with serial contracting, and with the advance nomination of the contractor. These methods of placing contracts should do even more than the recommendations we have made here to hring ahout better feedback on economical design from contractors to designers.

4.10 Contractors are not the only source of information relevant to economical design. Those concerned with land acquisition can also help. In considering the line and level for a new road, designers are at pains to avoid demolishing huildings, or severing farms, at least as far as they can; in so doing they may add disproportionately to the cost of the scheme. The evidence we quote in paragraph 7.13 on the increase in the cost of earthworks required for each square yard of finished road implies that it is increasingly expensive to adapt the line of a new road so as to preserve existing property. *We therefore recommend the Ministry to ensure that schemes are not made disproportionately costly by the attempt to preserve existing property.*

Supervision

4.11 We turn now to the supervision of the contract, that is the control that the engineer exercises over the contractor's progress and performance in its execution. Normally the engineer is also the man who has been responsible for the design of the project. In the earlier stages of the road programme, towards the end of the 1950s, relations hetween engineers and contractors were difficult. Both contractors and engineers were unfamiliar with the specification, and with its interpretation. There were no recent precedents on the application of the conditions of contract to major road works. The specification was inadequate in certain respects and variations were often ordered during the execution of the work. On these and other grounds, claims were rife. Experience has accumulated, and these evils have hecome less prevalent than they were. Nevertheless, contractors consider that there is still too much variation hetween one engineer and another in the interpretation and enforcement of the specification. What is acceptable to one engineer is not accepted by another. Engineers who are unfamiliar with the demands of the highly mechanised techniques employed in modern major roadworks are still appointed to supervise such projects. However quickly they learn the ropes, they learn them either at the

contractor's cost or else at the client's; in any case, ultimately, at the nation's cost. So long as the design and supervision of road construction contracts is distributed so sporadically among many teams, this will not change. If the distribution of design and supervision work can be rationalised and concentrated, as we have recommended in paragraph 4.4 above, the variations in the enforcement of the specification, and the mistakes of those inexperienced with it, should be less prevalent.

4.12 We have referred to the fact that some county councils are appointed as agents by the Ministry of Transport to design and supervise major trunk road and motorway projects. The reasons are largely historical: highway administration was a local authority responsibility before the Ministry of Transport was ever created. The county council is already the Ministry's agent for the maintenance of trunk roads, and is fully responsible for the construction and maintenance of other roads in its area, and there are still real advantages in the local knowledge that a county surveyor and his staff can bring to bear on a project. It must be understood however that while the county surveyor himself and his staff are really engaged in a Ministry project, the local council's own position is largely formal. We do not recommend that the Ministry should cease to employ county surveyors to design and supervise major road projects; *we do recommend the Ministry to consider whether the arrangements under which county surveyors are at present appointed as engineers can be improved.*

4.13 Contractors are naturally impatient about the time it takes to settle problems that arise while a contract is in progress (whether it is supervised by a county surveyor or by a consultant engineer). Since the early days of the motorway programme, when this problem was particularly frequent and acute, the procedures of the Ministry have been streamlined, and engineers have developed a better appreciation of the sort of problems that should be referred to the Ministry, and the sort which can or must be settled on the spot. Nevertheless, difficulties still arise on this score. The longer it takes to decide that a variation is needed, or to settle a dispute about the acceptability of work done, the more time and the more real resources are wasted. Such delays are more common and more protracted in work in the public sector than they are with private clients. We do not see why more time and more real resources should be wasted simply because they are paid for out of public funds. We understand that the present reporting procedures for major road works were devised to meet the requirements of the Public Accounts Committee of the House of Commons, when they were critical of the degree of financial control exercised by the Ministry in some early motorway contracts. Now that there is more experience on all sides, we think the time may have come to relax control from the centre. *We recommend the Ministry of Transport to consider whether greater efficiency would be achieved by further delegation of its authority to the man on the spot.*

4.14 Contractors are entitled to interim payments at monthly intervals during the execution of a contract. These payments are related to the estimated contract value of the permanent work executed up to the end of the previous month. We are satisfied that the present arrangements work in an equitable way and that there is little general complaint about delays in the making of interim payments for road works. We are concerned, however, at the amount of effort that the present system demands. Provisional measurement of the work for the purpose of certifying claims for payment takes an appreciable part of the contractor's and resident engineer's time, and difficulties over provisional measurement are

the main reason for such delays as do arise. *We therefore recommended the Ministry to consider if it can modify the system of assessing and certifying interim payments, so as to reduce the call on highly skilled professional manpower, without inequity to the client and the contractor.*

Statutory undertakers' works

4.15 The construction of a new road generally involves the diversion of mains, sewers, cables and power lines, and often engineering work on railway lines. All public utilities have special problems of maintaining an adequate service while their apparatus is modified or diverted, and the diversion-works themselves have the technical features peculiar to the service affected. Statutory undertakers are therefore entitled by statute to control the execution of these works, and to be reimbursed by the highway authority.

4.16 The statute gives the highway authority no means of ensuring that the statutory undertakers concerned carry out their works at a time, or in a way, that fits in with the road-construction operations. To fit in may not be particularly convenient for the statutory undertakers. As they have neither the obligation nor the incentive to fit in, they often fail to do so. What is worse, the statutory undertakers often fail to give the contractor sufficient warning and a firm date for the execution of their own works.

4.17 In general, the arrangement which is most convenient or economical to the statutory undertaker may well not be the most economical reconciliation of the interests of all parties. If it is not, resources are wasted, and, of course, the client pays for this in the end. The contractor naturally protects himself against uncertainties of this kind when he submits his tender, and so the Government itself probably pays in the end rather more than the actual cost of the resources wasted. We do not see why this should be allowed to continue. *We recommend the Ministry of Transport to consider holding discussions with other public authorities in order that conflicts between its interest and theirs over the diversion of their services can be sensibly reconciled.*

4.18 It is the statutory undertaker who has the last word on the diversion works that are required, but the highway authority has to bear the cost. Consequently the statutory undertaker may be tempted to require the modification works to be carried out on too generous a scale. We see no reason why the cost of road construction should be inflated in this way, and *we recommend the Ministry of Transport to consider whether any safeguard should or could be devised against excessively costly statutory undertakers' works.*

Summing-up

4.19 The problems we have discussed in this chapter have been largely problems of communication. One of the advantages of a more concentrated and rational distribution of design work is that the best practice would spread and permeate through design organisations more rapidly and more completely. Poor feedback from road-construction contractors to designers is another failure of communication. The misunderstandings that arise in site supervision, the anomalous position of the county council, the delays in settling matters that arise in the execution of a contract, the difficulty of fitting statutory undertakers' works in with the road contractor's work can all be taken as exemplifying poor communication. There is nothing new about the observation that communication is poor on the whole in the construction industry. It needs to be said again,

however, and it needs to be said with particular reference to some aspects of road construction. The recommendations which are made in this chapter, and some of those we make in other chapters, are intended to make the processes of communication simpler, quicker and clearer. If these recommendations can be carried out they will certainly promote greater efficiency in road construction.

5 Contractual Relationships

Introduction

5.1 In considering contract procedures in major road construction projects, we have had the advantage that the Banwell Report on the Placing and Management of Contracts for Building and Civil Engineering Work, published early in 1964 (reference 5) covered its subject very thoroughly. That report states clear conclusions on almost every aspect of contract procedure that has been raised in our own discussions of major road construction contracts. On every aspect we have discussed, their conclusions and recommendations seem to us to point in the right direction. In some instances, applying these conclusions to large-scale road works may be far from straightforward. We are glad to say that where they are straigbtforward to apply to work of this kind, they bave in general already been adopted with considerable success. This strengthens our confidence that, if others too can be applied, contractual relationships in road-construction will be so much tbe better.

5.2 We do not think it is necessary to develop in this report the general case for changes wbose merits have already been deployed in the Banwell Report. Nor need we examine how far each of the conclusions of that report bas been acted upon, since that is the task of the Economic Development Committee's Working Party on the Implementation of the Banwell Report. We enter into a detailed exposition only where their recommendations present special problems, or special advantages in major road works, or where we discuss aspects which that report did not.

The use of selective tendering

5.3 The wider use by public authorities of selective tendering was one of the most important recommendations in tbe Banwell Report. When the report was published, the Ministry of Transport bad already introduced selective tendering for major road contracts. They and the industry have now had three years' experience of it. It is worth recording tbat this experience has been wholly favourable, and that the transition from open to selective tendering was smooth and easy. All sides of the industry consider that selective tendering has helped to create a better atmosphere of mutual trust and confidence; in particular there is a freer flow of information between contractors and the Ministry, and the adjudication of tenders is simpler and quicker.

5.4 We concluded in chapter 2 that at present major road contracts engage too many firms for efficiency. There has been, it is true, a gradual trend to greater concentration in the last two or three years, whether or not as a result of selective tendering procedure. We concluded that the time has now come for the process of concentration to be given fresb impetus, and we recommended that selective tendering should be used with purpose to promote it.

5.5 Since tbe introduction of selective tendering, the Ministry had generally received eight or nine tenders per contract; never less than five, nor more than

twelve. It seems a pity that seven-eighths of the work that contractors put into the tendering process should be wasted. The cost of tendering is not negligible, indeed the professional men who prepare tenders are a scarce and valuable resource and in the end the client pays for their work, whether it is fruitful or not. Clients naturally wish to ensure, if they use competitive methods for placing contracts, that they do not miss the best price that might be offered. Private industry in this country, however, and some highway authorities in the United States, are content to receive about four tenders. This should suffice. There is no reason why a public authority should take its scruples to extremes. *We therefore recommend the Ministry of Transport and other highway authorities to be content with about four tenders for each contract.*

5.6 If this recommendation is adopted, it will be a considerable help to other developments that we consider desirable. First, there has already been a useful advance in the amount of collaboration between client and tenderer, and between engineer and tenderer. We shall go on to say how we think this should be taken further. Collaborative working, however, will be greatly helped if the client or the engineer has to be available for consultation with only four or five firms, rather than with eight or nine. Second, and more important, if contractors have less tenders to prepare, they will have both a greater incentive to tender well, and more resources to devote to tendering on each occasion. Both should lead to better planning on their part and to better contract execution.

Information available to tenderers

5.7 It is traditional in the construction industry for contractors to complain that they are given too little information when jobs are put out to tender. It is also traditional for groups such as ours to say that they ought to be given more. Before we say that, we must make one or two observations. First, contractors differ in what information they require and what importance they attach to any particular bit of information. Tendering involves several firms, and it is very difficult to predict whether a particular piece of information that the engineer has might be of value to one or more of the tenderers, or of no value to any. On the whole, however, too much information is better for tenderers than too little. Any uncertainty in the contractor's mind about what the job will involve tends to make him raise his price. So, in their own interests, clients should be generous with information when they go out to tender, nor should contractors hesitate to ask for it. The more clearly and simply it can be presented in descriptions of the job, in bills of quantities, and in drawings, the more it will help tenderers.

5.8 There are two matters about which contractors are particularly likely to find themselves uncertain: ground conditions, and the acceptability of available materials. The engineer will often have had long general experience in the locality and will have had time to find out a great deal about these matters. It is the practice, of course, to give all tenderers much information on the results of soil surveys, and if any tenderer asks the engineer for further information, he gives it, if he can, to that tenderer and to the others. Even so, contractors never have all they would like. They often find that a particular piece of ground, whose conditions are of special importance, requires additional investigation. They have little time to investigate it, and if they do, there is a waste of effort in their doing so separately and simultaneously. Alternatively, they must remain in doubt, and provide in their tender against the risk of the

worst case. The Ministry is experimenting with an earlier approach to tenderers in relation to the time when tenders are due, and if this practice is generally adopted it would enable contractors interested in the scheme to decide what additional information they would like, and for that information to be collected. *We recommend the Ministry of Transport to consider whether by these or other means they can give contractors fuller information about ground conditions so as to reduce their uncertainty and therefore their prices.*

5.9 The natural materials – stone, sand and gravel – that can be used for road building are very variable. The specification can define precisely only some of the aggregates that are to be accepted. Inevitably, there are materials whose acceptability is marginal. Some entirely satisfactory materials are marginal only because they are too unusual for the specification to provide for them. Some can be satisfactory provided that they are won or worked in the right way or in the right weather. Some vary in performance, and can only be evaluated if a sample from the particular source envisaged for a contract is submitted to a practical trial. Doubts about the acceptability of a natural material in a particular contract need not imply that its use is likely to result in a road of doubtful performance.

5.10 The cost of a bulk material depends very much on the distance it has to be hauled, and the extent to which it has to be processed. As the acceptability or unacceptability of a single material could make a difference, in an extreme case, of as much as £100,000 or more in the cost of carrying out a £5 million contract, the contractor is very anxious to resolve any uncertainty he may have at the tender stage about the acceptability of materials.

5.11 It has been suggested that engineers should make a prior assessment of all local sources of natural materials, and should send tenderers guidance with the contract documents on what will be accepted, and what will not. As has been said, however, the engineer cannot know in advance whether a contractor is going to use a material in such a way that it will be acceptable. Equally, he may not know of the existence of materials that contractors might choose to use. He will feel he can only mention those sources of material for whose extraction planning permission has already been given. For these reasons, we do not consider it practicable for the engineer to assess all local sources of natural material, and guide tenderers on their acceptability.

5.12 We think, however, that contractors could and should be given more certainty here. They could at least be told of aggregates that the engineer knows he will accept. Some engineers employed by the Ministry already state local sources of material which they know to be worth exploring, without prejudice to the contractor's responsibility. It is sometimes argued that if the engineer were to go further and nominate materials, contractors would probably find the price for them steepens. This may happen, but until it has been tried no-one can really tell if it will, or how important the effect will be. If the effect is serious, safeguards can be sought out, or if necessary the practice can be discontinued. Nor need the practice derogate from the responsibilities of the contractor. We think this is worth a trial. *In short we consider that, without prejudice to the contractor's responsibilities, engineers should make a more general practice of informing tenderers of sources of natural material which they know will be acceptable, and that the nomination of sources of material should be tried out.*

5.13 It has been increasingly recognised in recent years that while they are considering the contract documents and preparing their tenders, contractors

will be uncertain on points of all kinds which may have some importance. If these uncertainties remain at the end of the tender period, contractors will provide in their price for the possibility that the uncertain points will not turn out in their own favour. Perfect clarity in tender documents is bound to be an ideal, and it has been increasingly usual for tenderers to make inquiries to the engineer on points of uncertainty, and for him to attempt to resolve them. The engineer's practice in most cases – the exceptions are of a kind we discuss in the next paragraph – is to give all the tenderers any guidance he gives to one; and this is a sensible departure from the old traditions of arm's-length dealing. *We recommend contractors to be readier to discuss frankly with engineers points of uncertainty that arise at the tender stage, so that as few as possible remain at the end of the tender period.*

The Contractor's Own Ideas

5.14 Where, however, the contractor has an idea which he thinks is as valid as what the engineer has specified, and which he could realise more cheaply, he may think it wiser to keep this idea to himself until he submits his tender. He may be afraid of disclosure, or the full attractiveness of his own idea may not become apparent to him until quite late in the tender period when it has been worked out fully. In this situation, he may choose to submit an alternative tender, that is, to base his tender on the assumption that his idea is accepted. However, alternative tenders present a problem to the engineer. He has to examine the alternative and decide whether it should be accepted or not; and if he cannot accept it he must establish what the tender price would be without it. All this takes time and prolongs the interval between the acceptance of tenders and the award of the contract. The Ministry already reserves the right to reject tenders which are subject to unpriced qualifications, and it should be borne in mind that if a contractor does not discuss his ideas with the engineer before he submits his tender he may waste a good deal of his own time and effort in working out an idea which the engineer cannot accept. Contractors increasingly recognise the advantages of informal discussions with engineers during the tender period. There is also a growing appreciation of the engineer's responsibility to distinguish between information which must be given equally to all tenderers and ideas which one tenderer can fairly regard as his own property. These points need to be more keenly appreciated however. *We therefore recommend contractors*

(*a*) *to bear in mind the advantages, as well as the disadvantages, of prior discussion, on a confidential basis, with the engineer of ideas for departures from the original design;*

(*b*) *in their own interests, to conform to the Ministry's requirements when they put in qualified tenders by submitting prices both for the original design, and separately, for any qualification they may wish to enter to it.*

5.15 The contractor's own ideas on the most suitable design for a project may be fundamentally different from those the engineer has embodied in the contract documents. This is more likely to happen with structural works than with road works, and, even there, very occasionally. The client finds this a difficult situation to deal with: if one contractor can devise a valid cheaper alternative, other tenderers might also be able to do so, and so if the one alternative that has been submitted is accepted, it may be felt that there has not been parity of tendering between the firms concerned. The Ministry has been examining this problem,

and has not, we understand, reached final conclusions on the best means of ensuring that, while waste of effort is avoided, no feasible alternative design is overlooked. We have no recommendation to make to the Ministry on how to deal with fundamental alternatives proposed by tenderers. We shall go on to consider in paragraph 5.23 how much scope there is for the introduction of design-and-construct contracting in major road works.

The significance of time

5.16 From the moment when contract documents are available to tenderers up to the time when the appointed contractor is ready to start work on the site, client and contractor are each impatient about the amount of time that the other takes to get through his activities. The time schedule is, in practice, in the client's discretion. He lays down the tender period, takes whatever time he thinks he needs to adjudge tenders and award the contract, and can then require the contractor to start work on site by a time of his own choosing. As a rule, eight weeks has been accepted by the Ministry and the industry as the normal tender period for the larger contracts, but the Ministry of Transport is now extending this to ten weeks. Some contractors have found the period allowed for some jobs uncomfortably short, and their prices will reflect the uncertainties that remain unresolved at the time when the tender has to be submitted. We consider that it is wise to allow enough time for the contractor who puts most time and effort into the preparation of tenders. An earlier approach to contractors, which the Ministry is trying out, would help.

5.17 The Ministry of Transport's practices in the adjudication of tenders are, in general, as speedy as they could be, and provide for the earliest notification to contractors of their prospects of success, in order that those who are unlikely to succeed can apply their minds to other jobs. We can hope for two further small improvements: the Ministry is experimenting even now with a shorter bill of quantities, and this might simplify the task of adjudication (we do not pronounce on the desirability of a shorter bill because it has already been widely debated in the industry and is now being put to the test). Second, as we have already said, the task of adjudication would be shortened and simplified if contractors avoided unpriced qualifications, and invariably priced both the original design and their alternative when they submit an alternative tender.

5.18 The Banwell Committee said 'The period between the appointment of a contractor and the commencement of work on site is critical in the development of a project. In this period the contractor has to organise his resources, and haste at this stage can ruin the prospect of a smooth, well planned and speedy operation. Time spent at this juncture does not mean that the job as a whole will take longer; indeed difficulties which might lead to costly delays after work has commenced can be thought out beforehand and avoided.' We agree. A contractor cannot finalise his work plan, make firm his arrangements with sub-contractors, plant-hirers and materials suppliers, and constitute the work force for a major road contract within a matter of days after his appointment. However careful his planning has been during the tender stage, however complete his arrangements for the supply of plant, labour and materials, however far he has developed these plans and arrangements between submitting his tender and hearing he has been awarded the contract, yet, when the contract is awarded he cannot be anything like ready to make a full and effective start on major operations on site. If a contractor is pressed to get on with the job too soon after the

contract is awarded, he will probably make no more than a token start on the required day. Not much is gained by this, and we are glad to find that both the Ministry and contractors recognise this.

Claims

5.19 Some uncertainties in the details of work to be done are inherent in all civil engineering contracts, particularly in highway work where the site is a long ribbon of land over varying terrain. This is recognised in civil engineering contracts by provisions which allow the engineer to vary the works, and for the contractor to claim for extra costs in specified circumstances. The alternative would be to put all contingent risks on the contractor to an extent that would be unsatisfactory to both client and contractor. Contractors would be bound to provide against such risks in their tenders.

5.20 However, the early motorway contracts gave rise to claims that were very substantial, and which have taken a great deal of time and trouble to determine. With hindsight we can ascribe the number and size of these claims mainly to the inexperience of the Ministry, of engineers and of contractors: the specification was unsatisfactory in parts, and some re-design was necessary after the contracts had been let and work started; and the parties were unfamiliar with each other's responsibilities under the conditions of contract in their application to major road works. Two important lessons emerged. Because of inexperience, not enough was done to establish and record the facts and agree a reasonable price at the time variations were ordered. In all too many cases, too, contractors gave notice of a claim at the time, but did not submit the supporting information necessary for the engineer to determine the validity and value of the claim until many months after the contract was completed.

5.21 Efforts have been made on all sides of the industry to apply the lessons learnt in the early contracts and it seems reasonable to assume that current contracts will give rise to fewer and less intractable claims. This is just as well, for the possibility of large claims casts doubt on the effectiveness and equity of competitive tendering. There is further progress to be made in this direction however. In particular some contractors still make a practice of submitting inflated claims, or claims for which there is little basis, probably because they have nothing to lose in the bargaining process and everything to gain. This practice is time absorbing and completely unproductive and *we recommend the Ministry, when they consider a contractor's suitability for further contracts, to regard an irresponsible attitude to the submission of claims as a factor to be taken into account.*

New forms of contract

5.22 We have referred elsewhere to the need for better feedback from contractors to designers on the practical cost implications of different designs. In paragraphs 4.5 to 4.8 we have made some suggestions that would bring about greater and better feedback, and we have made further recommendations to this end in this chapter. Even if all these suggestions are adopted, however, the responsibility for design will remain separate from the responsibility for production. Whatever means are devised to improve liaison between those responsible for these processes, some opportunities for economy are likely to be lost as long as the responsibility remains separate. It has never been the general practice in road construction in this country to appoint a contractor to carry out both the design

and the construction of a project. We have considered how far this might be feasible.

5.23 The preparation of a road project involves not only design, but also the legal processes of establishing the line of a road, and of acquiring land for it. The processes are not separate. A line that is ideal on engineering grounds may not be adopted because it is unacceptable on planning grounds. So there should be interaction between the two processes (we say more about this in paragraphs 4.10 and 6.19). As things now are, these processes extend over a period of, typically, five years. This is a long commitment for contractors, and would be a commitment to much work in an unfamiliar line of country. Accordingly we do not think it is possible to give contractors the responsibility for design for road works. There are other ways however in which the main contractor can be appointed and brought into the team before the design is finished and the programme of work finally settled. Two methods, both strongly advocated by the Banwell Committee, have not yet been tried out in road construction: serial contracting, and advance appointment of the contractor.

5.24 In other types of construction work, serial contracting has been tried out to some extent in recent years, in order to improve the feedback from the process of execution to the process of design. In serial contracting, the first project of a series is placed with a contractor after competition; this stage of the contract is specified in detail, and bills of quantities are available. As part of the contract, however, the contractor undertakes to execute the subsequent projects, described at this stage only in outline, once their detailed design has been completed. For his part the client undertakes to employ the same contractor for the subsequent projects. The price for the subsequent projects is based on prices for items in the first project, and rates for new items in the subsequent projects are negotiated.

5.25 Apart from providing feedback from contractor to designer for the later projects, serial contracting gives the contractor more time to mobilise resources for the later projects, and helps to ensure that he can have continued use of the resources he has mobilised when he wins the contract for the first project; as a result, too, thinking on the contractor's side is not largely wasted (as it is in the preparation of unsuccessful tenders or in speculation about the provenance of work in future) but is wholly directed to the best application of resources to a job he knows he will have to carry out.

5.26 In 1964, the Banwell Committee saw no reason 'why public authorities generally need to be deprived of the opportunity to make use of such methods by adherence to established notions of public accountability'. Their view is now widely shared. After all, the first project in the series is the subject of competition. If the client is running risks in offering serial contracts, so too is the contractor in accepting them: serial contracts are necessarily fewer and larger, and if the contractor's performance is not satisfactory his reputation and goodwill suffer the more. The planning processes which we discuss in chapter 6 raise a difficulty because at present they make starting dates uncertain. We recognise too that between different road construction contracts there is less similarity in the site conditions, and the details of operations than there is in some other construction work, and that it is therefore less easy to devise satisfactory arrangements for serial contracting in road works than it is elsewhere. For all the difficulties *we consider that an experiment with serial contracting in roadwork is urgently needed.*

5.27 Serial contracting will succeed only if the projects in a serial contract are

of the right size, and if the operations in each are so phased as to ensure continuity of work, so that, for example, earthmoving equipment can be moved forward progressively from one project to the next. At present, it is generally accepted on all sides of the industry that a new length of motorway should normally be divided into contracts of about six miles, provided that the length of new road affords satisfactory connections with other roads; but this rule does not appear to have been arrived at by any analytical process. We believe that research, possibly on operational research lines, may make it possible to determine more closely both the optimum size of projects, and the optimum phasing of successive operations in different circumstances. A study of this kind could only be done with full co-operation between the Ministry of Transport and the Federation of Civil Engineering Contractors, and indeed, it would require the active co-operation of one or more firms of contractors. *We therefore recommend the Ministry of Transport, as a matter of urgency, to commission a study to determine the optimum size of projects, and the optimum phasing of operations for serial contracting in road construction. We also recommend the Federation of Civil Engineering Contractors and individual contractors to support and co-operate in such a study to the fullest extent.*

5.28 Even with serial contracting, however, the first contract is designed, necessarily, without reference to the particular capabilities of the contractor who eventually wins the contract; and the second or subsequent projects may have reached a stage of design that prevents their full exploitation. In private industry, it is not uncommon for the contractors to be appointed after competition a year or two before the design is fully worked out. Prior appointment of the contractor may result in a price lower than open competition can procure, for, provided that he has a satisfactory financial incentive, the contractor will be applying all his expertise to cost reduction in every phase of the contract. True, some of the obvious safeguards of competition are lost, but this need not be a conclusive consideration. If a contractor does not give satisfaction in the preliminary phases as well as in the execution of the contract, he need not be appointed again. We know of no grounds for supposing that in this matter public officials will be more prone to errors of judgement, to favouritism, or to corruption than managers in private industry. *Accordingly, we recommend the Ministry of Transport with the agreement of the Federation of Civil Engineering Contractors to consider an experiment with appointing a contractor for a contract a year or two before the design for the scheme is complete.* We have observed elsewhere (paragraph 4.13) that they should not be inhibited by conventional ideas of public accountability. These too can be changed.

Summing-up

5.29 It was once believed that competition among contractors was sufficient to ensure the lowest possible price in constructional work, and that the client should be satisfied so long as his projects were the subject of keen and wide competition. It is now generally recognised that competition is not enough: in reality, open competition may squeeze profits job by job, but does not encourage long-term cost saving; and the old beliefs give rise to practices which have been harmful – the separation of design from construction, which can lead easily to extravagant design and expensive construction, the mutual suspicion of engineer and contractor causing grounds for claims which need not have arisen, and a host of unnecessary misunderstandings and misconceptions. All sides of

the industry have increasingly recognised the old doctrines, attitudes and practices as harmful, and contract procedures have been adapted in various ways to palliate the worst effects of open competition. The road programme has, perhaps, made more progress in this direction than other public works programmes. Nevertheless, some practical possibilities have still to be tried out. We have identified a number that we think should be. Competition is not, after all, an end in itself. Value for money is.

6 Planning Procedures and Land Acquisition

The present procedures

6.1 One of the most prevalent complaints about the road programme in this country today relates to the time and the work involved in legal procedures that establish the line of a new road, and in the acquisition of land for it. We have therefore tried to see how strong the grounds of complaint are here, and whether the situation can be improved. Our description of these legal procedures relates to those which govern the Ministry of Transport in its preparation of trunk road and motorway schemes; there are differences in the procedure governing local highway authorities. We have not in general, spelled these differences out, but we must make it clear that many of the lessons we draw apply as forcibly to these authorities as they do to the Ministry of Transport.

6.2 Generally, about five years elapse from the time the Ministry decide to go ahead with a major project to the time when they are ready to invite tenders for it. This is a long period, considering that the scheme only involves perhaps two years of civil engineering work at the end. Design goes ahead at its own pace, and certainly need not take more than two years for most projects, but at three points in the preparatory process the Ministry must advertise its proposals – for the main line of the road, for the treatment of side roads and the stopping up of private accesses, and for the plots of land that it expects to require. At each stage there is a period during which objections can be put in. If these objections cannot be settled by consent between the Ministry and the objector, a public inquiry may have to be held, and the decision on the inspector's report on the inquiry must be taken by the Minister. Proposals for each stage cannot be advertised until design has been taken far enough for the consequent requirement to be clear. The decision at the end of each process may require some design work to be done again, indeed, sometimes a process may have to be repeated. While the need to track back does not arise often, it always might, and so until the line of the road and the layout of side roads have been settled the design team can make only limited progress. All this is inescapable as the law now stands.

6.3 We are aware of the reasons that led Parliament to prescribe this cumbersome procedure. Those who are affected by the construction of a new road must not be left at the mercy of an impersonal bureaucracy. Their point of view and their difficulties must be given fair consideration. It is not easy for us to pronounce on the importance of this principle, or on how it should be balanced against considerations on the other side. We are bound however to mention the implications that this has for the road programme. The present planning procedures give rise to two sources of difficulty: first, the processes take a long time, and second, their duration is uncertain.

The consequences of the present procedures

6.4 The long time taken locks up professional manpower for too long. It reduces

flexihility in the deployment of designers, and results in too much turnover within the design team during the design process. The five-year preparatory period also makes it difficult for the forward road programme to he adjusted except at long notice. Forward planning is all very well, and there are many advantages to all concerned if the Government gives definite indications five years or so ahead of the schemes it means to start. The Ministry is committed too far however, if it cannot by any means take effective steps to alter the priority of schemes in its programme, or bring into use a new stretch of road in less than seven years from the time at which the need for it hecomes apparent. The same argument applies to the introduction of general innovations of policy or procedure – for example the greater concentration of design work in the hands of fewer and more specialised teams. The Ministry say that they put into the pipeline enough schemes for the funds they know will he availahle five years ahead. In the circumstances, this is the hest they can do, hut it is less than satisfactory.

6.5 The uncertain duration of the planning process has its consequences too. The Ministry of Transport gives fuller and more detailed information ahout projects in preparation than is available for any other activity within the construction industry. These forecasts, however, are much less useful than they might be, hecause they indicate only that the schemes listed should be authorised within the five years. No closer indication of timing is given. Although no contractor can count on getting any particular future scheme, a firm would find planning easier if it could form a general impression of the distribution of future work through time. Suppliers of materials too would he helped hy closer forecasts, and we have made a recommendation on this point in paragraph 3.16. The Ministry is inhibited however from giving more definite public forecasts on matters of timing, hecause it does not know itself how things will turn out on any particular scheme.

6.6 Contractors have complained about cases where entry to land has not been secured in time for them to get on with the contract in the way they would wish. The Ministry has tackled this prohlem, and we think it arises now only in exceptional cases, where there are last-minute difficulties over such matters as re-housing. Again, because some schemes get through the planning processes smoothly, and others with more difficulty, there have heen areas with a heavy concentration of work all at one time; as a result, the flow of work for design and supervision teams hecomes erratic, and there is local overload of demand and stiffening of prices for materials. All this seems to leave too much to luck on a matter where more assured planning would result in economies.

6.7 *We consider then that useful economies would be gained by shortening preparatory procedures, and by making their duration less uncertain.* We think that this is becoming increasingly important. The success of serial contracting, and of other innovations in contract procedure, the rapid practical application of the lessons of experience, the improvement in the information given to contractors, suppliers of materials, and others, as a hasis for their own planning, all depend to some extent on making these procedures shorter and more predictable in their duration.

Establishing the line

6.8 It will not be easy for the Ministry to achieve hoth greater certainty and a shorter duration in estahlishing the line of a road and the treatment of side roads. For in general either can be achieved at the expense of the other. It is

legally possible for the Ministry to go through the statutory processes concurrently – that for establishing the main line of the road and the treatment of side roads, for example, at the same time. This they do in some cases. If there is no setback, the time required is shortened, but they run the risk that if the main line proposed is not itself adopted, work done on designing the layout of the side roads will prove abortive and extra time will have to be spent on redesigning them. Again the Ministry spend much time, before publishing their proposals in discussions with public authorities and other interests, to make as sure as they can that no substantial objections will be made when their proposals are ultimately published. They spend more time in negotiations with individual objectors, in the attempt to get objections to their proposals withdrawn and so remove the need for a public inquiry. If they made a practice of spending less time in these discussions and negotiations, then the objections made at public inquiries would more often be weighty enough for them to have to modify or abandon their published proposals and, in the worst case, start again. *We can only recommend the Ministry to consider again the balance of advantage between a shorter duration and a surer outcome in the work of establishing the main line of a proposed road and the treatment of side roads.*

The Principles of Land Acquisition

6.9 It should be much easier to predict the length of time required for securing entry into land, in order that roadworks can begin. Entry into some land can be secured by negotiation, but under the statute highway authorities can enter and acquire land by means of compulsory powers if negotiations do not result in agreement. The exercise of these statutory powers takes time. The interval between final decisions on the engineering layout, and entry into the land cannot, as things are, be less than 18 months if these statutory powers are used and objections are heard at a public inquiry. If the preparation of a road construction project is on a critical path schedule, it is generally found that the compulsory processes of securing entry to land are all on the critical path; that is, within limits, the date at which the works start depends on the time these processes take. Any delay or setback cannot be recovered. In our view, the statutory processes were designed by Parliament to provide all the necessary safeguards for the rights of individuals affected by a road construction scheme, *and we consider therefore that in general, there is no obligation on highway authorities to prolong negotiations with property holders in any way that will delay the start of roadworks beyond the time the statutory procedures would require.*

6.10 Thus, in the first place, the preparation of a compulsory purchase order can start at the same time as negotiations for purchase by agreement, that is as soon as the engineering layout is settled. It takes between four and six months to prepare a compulsory purchase order; there are then set periods for those affected to lodge objections, for notice to be given of a public inquiry, and, once the order is made, for the highway authority to obtain possession under a notice to enter. About twelve months are taken from the publication of the compulsory purchase order to the date of entry. Some land can be acquired by agreement within this total period of eighteen months. For a large scheme, however, which will involve many plots, it is nearly always necessary to go through all the statutory processes for some plots.

6.11 Some public authorities so strongly prefer to reach a settlement by negotiation, that they delay their decisions to start the processes of compulsory

acquisition until the valuer reports that his efforts to secure agreement have failed. This holds up many schemes. We are aware that public authorities are very conscious of their position as elected representatives of the people, and consider that they owe it to the public to show every willingness to negotiate; but they also owe it to the public to get the road built. *We consider that as it becomes possible for a highway authority to start each successive stage of the statutory procedures, it should proceed to do so for any plots which have not already been secured by agreement.* This will envolve starting the compulsory procedure eighteen months before entry is required.

Aspects of land acquisition

6.12 The statute provides special safeguards to local authorities, nationalised industries and other public bodies against the acquisition of their land by compulsory purchase. An order to which these bodies object requires the assent of Parliament which, if given, takes about eight weeks. We understand that there is, nevertheless, a reluctance on the the part of some highway authorities over making compulsory purchase orders on public bodies, and here again hesitation means delay. Such hesitation is, we think, unwarranted. There is no obligation on highway authorities to prolong the process of securing entry into land by extending negotiations beyond the time required by statute.

6.13 The amount of compensation to be paid for land is bound to give rise to disagreement between the valuer who conducts negotiations on behalf of the highway authority and the property holder. However, there is no reason why these disagreements should delay the time when the highway authority takes entry into the land. The Ministry of Transport is ready to make an advance payment, amounting to 90 per cent of its own estimate of the value of the land, when it takes entry under its statutory power. Under this arrangement landowners do not have to suffer the inequity of waiting for all their money, and so it encourages them to allow entry early on. Since it was introduced in 1959, the arrangement has been widely used by the Ministry of Transport and has proved invaluable to it. We know of no legal of financial obstacle which could prevent other highway authorities from doing the same and so *we recommend all highway authorities to make advance payments in order to secure quicker entry to land.*

6.14 In acquiring land for roads, highway authorities like other public bodies are statutorily bound to pay the market price for the land in the best alternative use permitted for it. Because landowners are apt to set a higher value on their property than this and to hold out for more, negotiations can be indefinitely protracted. Some highway authorities are not prepared to use the arrangements we have commended for paying advance compensation, or to resolve in time that, if negotiations are not to defer the start of road works, compulsory powers must be used to secure entry into the land. We think that if they are not prepared to be firm, they should instead be generous. For there is a cost to the community at large if a project is delayed, a cost which may far exceed the difference between the amount of money that is offered and the amount that would satisfy the property owner.

6.15 We recognise that if public authorities were to pay more than a recognisable market price in even a few instances, there would be a quick chain reaction. More and more landowners would stick out for payment over the odds, and would be advised to do so by their agents. Nevertheless, if the overall effect were an increase of 5 per cent in the cost of land to highway authorities – say

1 per cent on the total cost of road construction, the benefits might still be worthwhile. We acknowledge that such a relaxation might spread into other fields with less satisfactory results. However, arrangements could be devised which kept the relaxation within the control of the department concerned, and which ensured a real saving of time. It would be possible, for example, to offer landowners a little more than the assessed market value, but only on condition that they settled quickly. If a landowner rejected this offer, the price would be settled, as it is now, by the Lands Tribunal, and not necessarily at as high a figure as the original offer. *We recommend the Ministry and other public departments to consider whether some modification can be devised in the arrangements for determining compensation for land required for public works, in such a way as to produce worthwhile time savings, and consequently cost savings.*

6.16 The negotiations between the valuer who acts for the highway authority and the property owner deal not only with the amount of compensation but also with the form and extent of accommodation works, that is new fencing, accesses or other miscellaneous works that are necessary to replace what would be demolished when the road is built. A good deal of time and trouble goes into discussions about these works. It is often convenient for them to be carried out by the contractor for the main roadworks. However, if discussions on what is to be provided go on too long, the contractor will be held up. This difficulty is not infrequent, and we think it is often unnecessary. The highway authority is bound to compensate the property owner for damage done to his property as well as for severance and for land taken. There is no obligation, however, to provide this compensation in kind. Cash is just as good. *We therefore recommend highway authorities to consider whether they can forestall difficulties or delays to contractors by offering to compensate property owners for damage in cash, rather than in the form of accommodation works to be constructed by the contractor.*

6.17 The work of negotiation with property owners is carried out by district valuers on the Ministry's behalf; some local authorities employ their own county valuers for their own schemes, but if the expenditure is to be eligible for grant from the Ministry, the terms of the final settlement must, under the present rules, be approved by the central government's own official, the district valuer (except in cases where it is settled by the Lands Tribunal). District valuers have a very heavy work load, and while they give priority to the larger schemes, they are often unable to make satisfactory progress, particularly on the smaller schemes. We can expect the burden on district valuers to increase, if the proposals in the Land Commission Bill are enacted. Changes that would reduce the burden on district valuers and would enable them to expedite their work deserve consideration therefore. It may be necessary to reopen the question, whether the district valuer's final approval of the terms of settlement is required before a local authority can complete the acquisition of land by agreement, using its own county valuer throughout.

6.18 We have said that it takes from four to six months for the Ministry to proceed from finalising the engineering layout of a scheme to the publication of a compulsory purchase order. The preparation of a draft order involves among other things the precise definition and justification for all the land required, and exact particulars of everyone who has an interest in it. We think that four to six months is a long time for these purposes. *We recommend the Ministry to consider the scope for earlier collaboration between those concerned with land acquisition, and those concerned with design in order to reduce the time taken after the layout*

has been settled. As for ascertaining who owns and occupies land, we understand that in some American states this takes a matter of days, but arrangements for land registration there are more systematic. *We consider thot the present orrangements for land registrotion in this country impose unnecessory deloys on the preparotion of rood schemes.* Whether these arrangements could be improved is a question that runs very wide of our field. However, they may well be equally unsatisfactory for the transfer of property for other purposes and *we think the whole question of lond registrotion deserves the broodest consideration in this light.*

6.19 We understand that the Ministry does not seek powers of compulsory purchase for areas to be used as working spaces by the contractor or to secure access routes for him. Each tenderer makes his own assessment of what he would require, and when he is appointed he secures for himself what he wants, it is left to the contractor to make his own arrangements. Sometimes however there are no practical alternatives; no choice of access routes or of ground for working spaces. In this situation the successful contractor must negotiate with a monopoly in order to secure the requisite legal rights. This can be expensive, and at the tender stage the contractors will provide against the possibility in their prices. We recognise that if the Ministry acquire these rights in advance contractors might not be satisfied with what the Ministry made available. *Nevertheless, we recommend the Ministry to seek compulsory powers to ocquire lond to be used as working spoces or os occess routes, where there is little choice.*

Aids to better planning

6.20 The Ministry intends to introduce critical path scheduling for preparatory work on all its schemes, and has started to use it experimentally. We can hope that this will help to reduce the time and the uncertainty of duration of this work. It should improve liaison between all concerned in each project; it should help to ensure that priorities between similar activities on different schemes are more clearly understood, and it should help the Ministry to take a clearer view of the likely starting date of individual projects.

6.21 There is one other step the Ministry could take to help contractors, and reduce their uncertainties. In order to give all contractors general assistance with their long term planning, it could publish two or three times a year its latest assessment of the timing, cost and nature (particularly the type of carriageway construction) of major schemes in the programme. The Ministry may have to change its forecasts considerably from one publication to the next. It should certainly make clear how much uncertainty there is in the forecasts. We think however that even uncertain forecasts are better than none. *We recommend the Ministry to develop its published forecasts of the future demond for work, in order thot they con give o better basis for plonning to contractors and others concerned.*

Summing-up

6.22 We have considered only the procedures for establishing the line of a road and for securing entry to land as they are within the present statutory framework, and our recommendations are directed to greater efficiency within this framework. It is not possible for us to say whether highway authorities and the nation are paying too high a price, in overall terms, for the preservation of the rights of individuals, through the three-stage legal process laid down by the statute. Any change would require the authority of Parliament. We know that in recent years a good deal of thought has been given, in the Ministry and

elsewhere, to various possibilities for streamlining the present procedures. We are not in a position to make recommendations on this matter, but we can record our uneasiness. It may be for instance that a new procedure could be devised, analogous to that in private-bill legislation, whereby at a single stage proposals are made for the line of a project within limits of deviation, and if the proposals are approved, the right to undertake consequential works (such as the treatment of side roads) and to acquire land compulsorily follows automatically. *We consider that the broadest consideration should be given to the question whether the real safeguards to the rights of individuals that the present procedures afford could not be afforded equally well, or better, by some shorter and simpler procedure with less serious consequences for efficiency and prices.*

6.23 In any case, we think the present statutory framework gives enough protection to property-holders and others affected by the construction of a new road. Individual property owners are offered every opportunity to make representations against a highway authority's proposals, and their representations are exhaustively considered. Great weight is attached to the views of public authorities. Clearly these processes of consultation and negotiation are necessary, and this is generally recognised. It should also be recognised however that protracted consultations and negotiations have a real (though not a measurable) effect on the economy with which the road programme is carried out. Highway authorities should not prolong these consultations and negotiations unduly; by good administration, they should be able to avoid doing so.

7 Costs, Prices and Productivity

Road construction prices

7.1 When we started work we received evidence from the Ministry of Transport about the trend of prices for road construction in the period 1960 to 1964. They reported that the prices highway authorities paid for new roads showed a very steep rise between 1960 and 1962 and a much smaller, but still substantial rise between 1962 and 1964. In this chapter we say what we can, at this stage of our work, about how prices have moved, how costs have changed, and what improvements there have been in the real value of output per man during the last five years.

7.2 The Ministry originally estimated that road construction tender prices rose by about 30 per cent between 1960 and 1962 and by 9 per cent between 1962 and 1964. This conclusion was reached after an adjustment had been made for changes in the Ministry's general specification, in order that the figures should indicate how prices moved for similar work, but it should be noted that we have concluded in chapter 3 that too little was allowed for specification changes. However for comparative purposes we have asked the Ministry to produce an index showing the historical trend of tender prices, irrespective of changes in the specification of the finished road. This shows tender prices in 1962 as 41 per cent and in 1964 as 54 per cent higher than tender prices in 1960. These figures cover road-construction projects of all sizes, and of all kinds. The evidence on cost-trends that we discuss later in this chapter relates entirely to large schemes, and we have considered whether a price index confined to these schemes would provide a better basis for comparison. We understand however that large schemes so predominate in the road programme, and hence in the Ministry's price index, that a large-scheme price index would not differ significantly from that given.

7.3 The Ministry's index of prices is based on tenders. We have pointed out in chapter 3 that prices in tender documents are not a reliable guide to the costs that the contractor actually incurs during construction. In the first place, these prices reflect the contractor's anticipation of future costs, and, in anticipating the future, the contractor will be greatly influenced by his recent and current experience of costs; a lag is therefore to be expected before contractors' changing experience of cost trends is reflected in changes in price trends. In detail, too, prices for billed items do not necessarily reflect the contractor's estimate of the actual cost of the individual operations, and these estimates in turn may prove to be wide of the mark. Moreover the client must also meet some claims which arise from costs that are actually incurred, but which are not provided for in the tender. We understand that claims are now less prevalent than they were on contracts let five years ago. It is not possible to say what claims will ultimately be upheld for contracts let recently, but we think there is now more realism in tender prices, and that if the changing incidence of claims could be taken into account, the price trend would probably rise less steeply than the Ministry's evidence indicates.

The road construction costs study

7.4 Whereas we had useful evidence on price trends, we found there was a dearth of evidence on the trend of costs over the last five years. There was no broadly-based account of the structure of costs of road construction, and little general information about the trend of costs for road-construction materials, plant or labour. Accordingly we decided to commission a study of road-construction costs in 1960 to 1964, and we retained Gardiner and Theobald, chartered quantity surveyors, to carry it out. A number of firms of contractors, who had started two or more major contracts for motorway or major trunk-road schemes in the period of 1959 to 1964, agreed to make information available to Gardiner and Theobald on a confidential basis. In the course of the study Gardiner and Theobald also consulted the Ministry of Transport, three firms of consultant engineers and three county surveyors who had been associated with some of the projects about which they had collected information from contractors.

7.5 Before we discuss the provisional conclusions of the Gardiner and Theobald study we must express our appreciation of the work they have done. Each contractor keeps his records in a different form, and allocates his costs in his own way. They have reduced a large and heterogeneous collection of data to a clear and orderly form, and have presented it comprehensibly and simply. This has been a complicated and arduous task, and we are very indebted to them for the tact, skill and despatch with which they have carried it out. We are also indebted to the contractors who agreed to participate in the study, and to the consultant engineers and county surveyors who made their experience available to Gardiner and Theobald.

7.6 Fifteen contracts were made available to Gardiner and Theobald and they were able to examine the costs incurred in the execution of all but a small number of them. They divided the contracts into three groups, according to the period in which they started; 'early' (starting in 1959 or 1960), 'middle' (starting in 1961 or 1962) and 'latest' (starting in 1963 or 1964). They presented all their results in these groups. For all the contracts in each group they have adopted a representative point in time and adjusted the actual costs to conform to it. They divided costs into those for labour, for plant and for materials; they allocated them to the main contract-phases: preliminaries, earthworks, drainage, carriageway construction, structural work and fencing and side-road works; and they attempted to adjust these allocated costs for changes in the costs of labour, plant and materials; they went on to attempt further allowances, for changes in the proportions that certain phases contributed to the whole cost of each group of contracts, but we shall need more time to analyse the significance of these intricate adjustments.

7.7 In general Gardiner and Theobald found consistent trends and patterns in all the contracts in each group, and so, although this sample is a small one, it is reasonable to regard the results as having some significance for the trend for the larger motorway and trunk road contracts. There is the possibility, all the same, that one or more of the groups, taken as a whole, presented peculiar features. For road contracts are very various. Bridges may be required more or less frequently; in different terrain the requirements for earthworks will differ and so will the problems of executing them. Materials will be more or less difficult and expensive to procure locally. Designers have a wide choice of types of carriageway and of structure, and contractors have a wide choice of methods

of construction. Designers and contractors aim alike to keep costs to a minimum within the limitations imposed upon them, but the means they adopt to this end are very diverse, and in consequence it is difficult to make balanced comparisons between road projects. It would be unwise to assume that the changes Gardiner and Theobald have found between the groups of contracts they studied are perfectly applicable to all major road contracts carried out in the period.

7.8 The study that Gardiner and Theobald have undertaken for us provides a more comprehensive review of recent road-construction costs than it has been possible for any single organisation to prepare before. Even so it cannot identify and quantify all the factors that have influenced costs in recent years. We have drawn attention in paragraph 3.5 to the need for a better understanding of road construction costs. We consider that the measurement of costs, prices and productivity in road construction is so complex as to require much closer analysis than we have yet been able to give it, before definite and detailed conclusions can be reached on it. For the present we think it would be rash to go beyond a simple exposition of this study's main results, or to draw more than the plainest provisional conclusions from it.

Results of the costs study

7.9 The principal cost-findings of the study are displayed in the table at the end of the report, which shews the costs actually incurred in the execution of each group of contracts. Between the early group and the middle group, overall costs rose substantially, by 32 per cent. In comparing this increase with the 41 per cent increase in tender prices we must bear in mind that between these groups of contracts there were, we believe, changes in the contractors' profit position and in the incidence of claims, and also that both figures are based on sample studies. Between the middle group and the latest group, there was no substantial change in over all costs, whereas tender prices continued to rise after 1962. Although it is not possible to state at this stage what the significance of this discrepancy is, two explanations suggest themselves. In part it may be an accidental consequence of sampling only a few projects; and the lag between cost trends and price trends, which we have mentioned in paragraph 7.3, probably played at least a part: after a long and steep rise in costs, we should expect prices to go on rising for a year or two, though, if the levelling out of costs is real and general, then other factors apart, future prices should also level out.

7.10 One of the factors underlying the rise in road-construction costs is the rise in prices which contractors pay to employ labour and to procure materials and plant. It is difficult to make accurate allowances for these inflationary trends, because in general the only available indices of cost cover the whole of the building and civil engineering industries; road construction is a specialised sector of these industries, and it cannot be assumed that the trend of its material costs or labour costs will move in step with the trend for the whole. However a first attempt was made, as part of the study, to allow for the influence of inflation, and it suggests that if it had not been for the rise in the cost of labour, plant and materials, road-construction costs would have risen by about 23 per cent from the early contracts to the middle contracts, and would have fallen by about 8 per cent between the middle contracts and the latest contracts.

7.11 It is customary in road construction to break on-site costs down into the six phases given in the table – preliminaries, earthworks, carriageway works, drainage, structural work and fencing and side-road works. In the following

paragraphs we take each phase in turn, and comment, so far as we can at this stage, on the progress of costs and productivity in each. Our measure of the cost of each phase is its cost per square yard of finished carriageway.

7.12 *Preliminaries* cover the wages and salaries of personnel not engaged in physical production, site offices and site facilities and other costs of employing labour such as hostels and transport for workmen. Preliminaries appear to have increased very substantially throughout the period of the study. This may be no bad thing, in so far as it implies more thorough planning and supervision. This item does not include head-office overheads, however, and, at 16 per cent, appears on the face of it to have become an unduly high proportion of the cost of a project; it might be lower if contractors were able to make more continuous use of the facilities and services which are accounted for under it.

7.13 The cost of *earthworks* increased very substantially between the early contracts and the middle contracts, and went on rising, so that in the latest contracts it was 55 per cent higher than in the earliest ones. Gardiner and Theobald have shewn that this is entirely due to increases in the quantities of earth moved. The early contracts required 5.2 cubic yards of earthworks per square yard of finished road, the middle contracts 7.8 cubic yards and the latest contracts 12.0 cubic yards. Thus over the whole period the real cost per cubic yard was reduced from 8s 8d to 5s 0d (the figures are approximately adjusted to conform to price levels prevailing in the latest period). While this reduction in the unit cost will owe something to economies of working on a larger scale, we presume that the main economy has derived from successful mechanisation which we know has been going on. Yet this substantial improvement in productivity has not been enough to counteract the effect on costs of the increased requirement. The significance of the greater requirement is not yet clear; in part it results from such changes in the general specification as flatter slopes for embankments and cuttings. It appears likely however that it is also in part an accident of sampling, for the earth-moving requirement depends very much on the terrain through which a new road runs. The fact remains that a substantial advance in productivity in earthmoving has been completely swallowed up in this way, and, whatever the reason, this brings out the importance of the right choice of line and level for a new road (see also paragraph 4.10).

7.14 *Carriageway works* include the preparation of foundations as well as the construction of the carriageway and hard shoulders, and the installation of traffic signs and lane markings (work on side roads is not included). The cost of these works actually decreased between the early and the middle contracts, and changed little after that, so that in the latest contracts it was 4 per cent lower than in the early ones. If we take account of the effects of inflation on labour, plant and materials costs, this is a very substantial and sustained improvement. Despite the fact that the general specification was stiffened so as to require increases in both the quality and the quantity of materials, the cost of both plant and labour was halved, and in the latest contracts accounts altogether for less than 30 per cent of the whole cost of carriageway work. We therefore think it likely that significant cost reductions in future would depend on a cheaper specification, rather than on improvements in methods of construction.

7.15 *Drainage*, which includes the provision of drains and culverts and the diversion of water courses, has shewn a substantial increase in cost. These costs appear to have risen by 78 per cent between the earliest contracts and the latest ones (by 56 per cent if an approximate adjustment is made for rises in earnings

and the cost of plant and materials). We attribute the increases principally to changes in the specification which were made necessary by the proven inadequacy of the drainage provided in the first motorway contracts. Compared with other phases, drainage costs include a high proportion of labour costs. We have said in chapter 2 that the requirement for drainage in this country is extensive compared with that in some countries abroad, and that plant for drainage has not been developed far in recent years. These considerations suggest that the development of better machinery for drainage operations could be particularly valuable.

7.16 The cost of *structures* (which include all underbridges, overbridges and viaducts) rose very steeply between the early and the middle contracts, and fell steeply between the middle contracts and the latest ones. The rise in the first period is entirely associated with increases in the quantity of work required, for the early contracts required 0.30 square feet of bridge deck per square yard of carriageway, whereas the middle contracts required 0.49 square feet of bridge deck. This results at least partly from changes in the general specification, such as flatter earthworks and wider hard shoulders entailing longer spans for overbridges; no doubt there were also differences in the number and nature of the obstacles to be crossed. The amount of structural work remained constant between the middle and the latest contracts, and the improvement in costs clearly indicates greater productivity. We think that more economical design, deriving from a greater cost-consciousness among designers, played an important part here. We hope this improvement is not yet at an end, and that, for example, the development of standardisation (which we have discussed in paragraph 3.13) will take it further.

7.17 Work on *fencing and side roads* (including the diversion or making good of any roads other than the new road itself) is a far more significant item of cost in this country than in many abroad. The requirement varies greatly from project to project, and no consistent cost-trends emerge from the study. This work remains an important item and a significant user of labour, and would probably repay further attention (for example on the lines suggested in paragraph 6.16).

7.18 Gardiner and Theobald were explicitly instructed not to attempt to analyse overheads and the profit element. It would be difficult in any case to separate overheads and profits, because there is a good deal of arbitrariness in the allocation of overheads. We can report however the general impression held on all sides of the industry that profits were very low in the early period, and that in some cases actual losses were made by contractors at that time, and that since then profitability has increased but not to an excessive level. We have no evidence to the contrary. This reinforces us in our opinion that a tighter squeeze on profit margins would not do much to reduce the price of roads.

Summing-up

7.19 *All in all there have been important advances in productivity in the three major phases of road construction. Plant has been used to better effect in earthworks and carriageway construction, and structures have been designed more economically. These advances have been counteracted, however, by increases in the client's requirements. They may also be masked by rises in the costs of labour, plant and materials. In consequence the Ministry has actually paid substantially more for the earthworks and structures associated with each square yard of finished*

carriageway, and only a little less for the carriageway works themselves. These three phases account for about 70 per cent of the whole. *For the rest, drainage and fencing and side-road works do not shew the same evidence of improved productivity, and preliminaries form an increasingly heavy tax on the job as a whole. We think that these phases deserve attention if road construction costs are to be reduced.*

7.20 Our task is to find ways whereby road construction costs can be reduced, so that the nation can have better value for the money it invests in roads. We are convinced that roads can be built more economically. Better value will be realized however only if in one phase and another each mile of road demands fewer real resources: that is, if the job calls for less labour, if it makes a more economical use of materials, and if plant can be used with greater efficiency. All this will require better administration and better planning on all sides of the industry. There is plenty of room for improvements; and the recommendations we have made elsewhere in this report identify those areas where we think the scope for improvement is most obvious, and the need for it most urgent.

Summary of Conclusions and Recommendations

We consider that seven aims should underly the future development of the road construction industry. These aims are:

(a) **more continuity of work,** for plant, for contractors' teams, and for design teams;

(b) **more specialisation in major highway works;** this too applies to plant, contractors' management teams, and design teams equally;

(c) **a more rational distribution of work** to a smaller number of contractors' teams and design teams;

(d) **better communications;** more feedback from contractors to designers on the practical cost implications of design; clearer statements by the Ministry of the contents of its forward programme, and of the prospects for contractors and suppliers of materials;

(e) **more collaborative working** between contractors and engineers, between engineers, contractors and statutory undertakers, between contractors and the Ministry. This might include earlier participation by the contractor in the preparation of some projects;

(f) **a close analysis of costs and benefits:** in the specification, and in the choice between alternative methods of construction (black-top or concrete paving, precast or in-situ bridge construction; shorter or longer contract duration);

(g) a clearer appreciation of **the price of public accountability:** in the time and effort devoted to consultations and negotiations before the requirements of a new road are statutorily established; in the Ministry's attitude to the risk of poor performance in the finished road; in its willingness to try out innovations in contract procedure – (paragraph 1.6).

We have reached conclusions that are consistent with these aims, and have made recommendations that would help to realise them. We now list our forty-one conclusions and recommendations.

1 The disposition of work should be such as to provide greater continuity of work for individual firms engaged in road construction (paragraph 2.7).

2 Not many firms can play an important role in the execution of major contracts in the road programme; in general there is little room for small firms as main contractors on large road construction contracts (paragraphs 2.8 and 2.9).

3 Both the Ministry and the contractors themselves should aim to concentrate the execution of major road-construction contracts in the hands of fewer teams (paragraph 2.12):

(a) the Ministry should ensure that the working of its selective tendering procedure enables all firms, including the largest, to have every opportunity to develop in standing and calibre, and in their capacity to take on more contracts at a time; unsatisfactory firms should be relegated or discarded (paragraph 2.15); and,

(b) firms that engage in road work would do well to make a substantial commitment to this activity, whatever else they may do so well; firms of all

sizes in the industry should consider the advantages of amalgamation, or of permanently combining their road-construction interests in jointly-owned subsidiaries (paragraph 2.16).

4 In considering investment in innovation, contractors and plant manufacturers should take an optimistic view of the likely growth of demand for better plant in this country and abroad (paragraph 2.20).

5 The Ministry should go on looking out for innovations in plant design abroad, and should promote trials of new plant in appropriate cases (paragraph 2.21).

6 The Ministry of Transport should consider the possibility of contractual arrangements that would give incentives for early completion as well as a liability to damages for late completion (paragraph 2.23).

7 The effect on costs of changes made in the specification in 1960–64 is (at 1964 prices) at least £110,000 per mile for dual-three lane motorways (paragraph 3.3).

8 The Ministry of Transport should build up a more exact model of the capital-cost implications of design requirements; contractors should assist the Ministry as far as they can in this (paragraph 3.5).

9 The Ministry should develop its techniques of appraising cost-effectiveness as a guide to decisions of technical policy, and should make extensive studies of the costs and performance of alternative specifications including those actually used abroad (paragraph 3.9).

10 The Ministry should keep the overall economics of prefabricated bridges under review (paragraph 3.12).

11 The Ministry has made useful progress with the promotion of standardisation. Its resources should be strengthened to enable it make further progress (paragraph 3.13).

12 The Ministry should publish from time to time forecasts of the likely demand for materials for roadworks, in a form that will help the suppliers of materials to plan and invest for a sufficient output (paragraph 3.16).

13 The Ministry should keep up to date its studies of the most economic balance between concrete and bituminous paving (paragraph 3.17).

14 There are too many design-and-supervision organisations engaged on major highway work, and the Ministry of Transport should consider further measures to rationalise and concentrate design work to the best economic advantage (paragraph 4.4).

15 Some additional means must be devised to bring to bear on designers' thinking the practical experience of contractors of the cost of alternative design treatments (paragraph 4.5);

(a) at the tender stage contractors should not be discouraged from submitting alternative tenders (paragraph 4.6);

(b) the Ministry should encourage engineers to discuss suggestions with a contractor who believes he can offer a significant saving, and subject to suitable safeguards to adopt them (paragraph 4.7); and

(c) the Ministry should ensure that the important findings of its meetings with contractors on cost-saving are disseminated clearly, quickly and universally among highway-design teams (paragraph 4.8).

16 The Ministry should ensure that schemes are not made disproportionately costly by the attempt to avoid disturbing existing property (paragraph 4.10).

17 The Ministry should consider whether the arrangements under which county surveyors are at present appointed as engineers can be improved (paragraph 4.12).

18 The Ministry of Transport should consider whether greater efficiency would be achieved by further delegation of its authority to the man on the spot (paragraph 4.13).

19 The Ministry should consider if it can modify the system of assessing and certifying interim payments, so as to reduce the call on highly skilled professional manpower, without inequity to the client and the contractor (paragraph 4.14).

20 The Ministry of Transport should consider holding discussions with other public authorities in order that conflicts of interest over the diversion of their services can be sensibly reconciled. It should also consider whether any safeguard should or could be devised against excessively costly statutory undertaker's works (paragraphs 4.17 and 4.18).

21 The Ministry of Transport and other highway authorities should be content to receive about four tenders for each contract (paragraph 5.5).

22 The Ministry should consider whether they can give contractors better information about ground conditions (paragraph 5.8).

23 Without prejudice to the contractors' responsibilities, engineers should make a more general practice of informing tenderers of sources of natural materials known to be acceptable; the nomination of sources of material should be tried out (paragraph 5.12).

24 Contractors should be readier to discuss frankly with engineers points of uncertainty that arise at the tender stage; they should bear in mind the advantages of prior discussion on a confidential basis of ideas for departures from the original design, and when they put in a qualified tender should price both the qualification as well as the original design (paragraphs 5.13 and 14).

25 When the Ministry consider a contractor's suitability for further contracts, they should regard an irresponsible attitude to the submission of claims as a factor to be taken into account (paragraph 5.21).

26 An experiment with serial contracting in road work is urgently needed. The Ministry should commission a study to determine the optimum size of projects, and the optimum phasing of operations for serial contracting, and the Federation of Civil Engineering Contractors and individual contractors should give the fullest co-operation in such a study (paragraphs 5.26 and 5.27).

27 With the agreement of the Federation of Civil Engineering Contractors the Ministry should consider an experiment with appointing a contractor a year or two before the design for a scheme is complete (paragraph 5.28).

28 Useful economies would be gained by shortening preparatory procedures, and by making their duration less uncertain (paragraph 6.7).

29 The Ministry should consider again the balance of advantage between a short duration and a sure outcome in the work of establishing the main line of a proposed road and the treatment of side roads (paragraph 6.8).

30 There is no obligation on highway authorities to prolong negotiations with property holders in any way that will delay the start of roadworks beyond the time the statutory procedures would require (paragraph 6.9).

31 As it becomes possible for a highway authority to start each successive stage of the statutory procedures, it should proceed to do so for any plots which have not already been secured by agreement (paragraph 6.11).

32 All highway authorities should make advance payments in order to secure quicker entry to land (paragraph 6.13).

33 The Ministry and other public departments should consider whether some

modification can be devised in the arrangements for determining compensation for land required for public works, in such a way as to produce worthwhile savings of time and so of money (paragraph 6.15).

34 Highway authorities should consider whether they can forestall difficulties or delays to contractors by offering to compensate property-owners for damage in cash, rather than in the form of accommodation works to be constructed by contractors (paragraph 6.16).

35 The Ministry should consider the scope for earlier collaboration between those concerned with land acquisition and those concerned with design, in order to reduce the time taken to prepare a compulsory purchase order after the lay-out has been settled (paragraph 6.18).

36 The present arrangements for land registration impose unnecessary delays on the preparation of road schemes, and the whole question of land registration deserves the broadest consideration (paragraph 6.18).

37 The Ministry should seek compulsory powers to acquire land to be used as working spaces or as access routes where there is little choice (paragraph 6.19).

38 The Ministry should develop its published forecasts of the future demand for work in order that they can give a better basis for planning to contractors and others concerned (paragraph 6.21).

39 The broadest consideration should be given to the question whether the real safeguards to the rights of individuals that the present statutory planning procedure affords could not be afforded equally well, or better, by some shorter and simpler procedure with less serious consequences for efficiency and prices (paragraph 6.22).

40 Since 1960, there have been important advances in productivity in the three major phases of road construction. Plant has been used to better effect in earthworks and carriageway construction, and structures have been designed more economically. These advances have been counteracted however by increases in the client's requirements. They may also be masked by rises in the costs of labour, plant and materials. In consequence the Ministry has paid substantially more for the earthworks and structures associated with each square yard of finished carriageway and only a little less for the carriageway works themselves (paragraph 7.19).

41 Drainage and fencing and side road works do not shew the same evidence of improved productivity, and preliminaries form an increasingly heavy tax on the job as a whole. These phases deserve attention if road construction costs are to be reduced (paragraph 7.19).

References

The following publications are referred to in the text of this report:
1 *American Road Construction Plant* (HMSO 1964)
2 *Specification for Road and Bridge Works* (HMSO 1963)
3 *Notes on the Third Edition of the Specification for Road and Bridge Works and on the Preparation of Bills of Quantities* (HMSO 1963)
4 *Guide to the Structural Design of Flexible and Rigid Pavements* (Road Note 29) (HMSO 1965)
5 *Organisation and Practices for Building and Civil Engineering* (the Banwell Report) (HMSO 1964)

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NATIONAL ECONOMIC DEVELOPMENT OFFICE

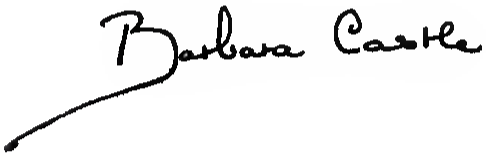
EFFICIENCY IN ROAD CONSTRUCTION

A REPORT BY A WORKING PARTY OF THE
ECONOMIC DEVELOPMENT COMMITTEE
FOR CIVIL ENGINEERING

LONDON
HER MAJESTY'S STATIONERY OFFICE 1966

Foreword by the Minister of Transport

I welcome this report on road construction, the first that the Economic Development Committee for the Civil Engineering industry has published. Like all the work of the Economic Development Committees it is a co-operative effort; contractors, trade unionists, civil servants, civil engineers from local authorities and consulting engineers, as well as independent members and the National Economic Development Office itself have all taken part in producing it. The report contains important lessons for everyone concerned with the road programme, and recommends a number of changes – many of them fundamental ones, both in the practices of my Ministry and of industry. I recognize that in nearly all cases the initiative must come from the Ministry and I am grateful for the guidance given by the Committee. There is great urgency to obtain better value for money in road construction and, with the help of all sides of the industry in following up this valuable report, I am sure we can get it.



Preface by the Economic Development Committee for Civil Engineering

This report was prepared for the Economic Development Committee for Civil Engineering by a Working Party under the Chairmanship of Mr J A Lofthouse. The report was presented to the Committee for discussion at its meeting on 18 April, 1966. The Committee considered that it would be helpful to have full discussion of the many wide-ranging issues brougbt up in the report and has therefore authorised its publication. Tbe Committee itself is meanwhile considering these issues and the action required.

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Preface by the Working Party

In June, 1965 the Economic Development Committee for Civil Engineering constituted us as a working party on costs and productivity in road construction. In our terms of reference, we were instructed:

(i) to examine the economic performance of the road construction sector of the civil engineering industry, especially in relation to costs and productivity; to consider ways of improving its efficiency and performance;

(ii) in particular:

(a) to examine trends of road construction costs and prices and the reasons for them,

(b) to consider methods of measuring productivity in road construction, to select the most appropriate and to examine the trends in productivity,

(c) to consider action to increase productivity and reduce costs;

(iii) to submit reports and recommendations on these matters to the Economic Development Committee for the civil engineering industry as appropriate, and to draw the attention of the Economic Development Committee to the possible relevance of their work to other sectors.

We were asked to submit a first report in the spring. It was understood that in the time we would cover only the salient issues, and that we should have to leave some problems over for consideration at the next stage of our work. We now submit our first report.

J A Lofthouse (*Chairman*)
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4 April 1966